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INSTRUCTION MANUAL

½ MC PULSE GENERATOR

MODEL 100

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DATAPULSE

MP MASTER
MA28771

INSTRUCTION MANUAL

½ MC PULSE GENERATOR

MODEL 100

Serial No. _____

Your DATAPULSE Model 100 Pulse Generator is a reliable source of medium power, fast rise time pulses. Full control of pulse delay, amplitude and repetition rate is available in this compact instrument.

This manual contains general and detailed instructions for use and maintenance of the Model 100. A complete understanding of its contents will contribute to full utilization of the broad capabilities of this instrument. Additional copies are available at extra cost from DATAPULSE or the DATAPULSE Field Engineer or Representative in your area.

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SECTION I

SPECIFICATIONS

1.1 INTERNAL REPETITION RATE

Continuously variable from 5 cps to 500 kc in five decade ranges. Each range is covered by a 210° vernier.

1.2 EXTERNAL TRIGGER

Requires 15v positive trigger, 0.1 μsec maximum rise time, 1 mc maximum repetition (25 volts required above 500 kc). Negative pulse may be used with accessory inverting transformer. Sync output occurs less than 20 nanosec following external trigger.

1.3 MAIN PULSE DELAY (of leading edge from Sync Output)

Continuously variable from 0.2 μsec to 0.1 μsec in six decade ranges. Each range is covered by a 270° vernier, at least 80% maximum duty cycle.

1.4 MAIN PULSE DURATION (at 50% Amplitude Point)

Continuously variable from 0.1 μsec to 0.1 μsec in six decade ranges. Each range is covered by a 270° vernier, at least 80% maximum duty cycle.

1.5 STABILITY, JITTER AND ACCURACY (Pulse Period, Pulse Delay and Pulse width)

Stability* is better than ±2%, jitter is typically less than 0.1% (repetition rate jitter is 0.5%). Full scale accuracy is ±5%.

1.6 MAIN PULSE WIDTH

Simultaneous positive and negative outputs. Positive pulse is dc coupled from less than 200 ohm source, baseline nominally at ground. Negative pulse is ac coupled from 1500 ohm source.

1.6.1 Amplitude

Load		Maximum peak amplitude	
Pos.	Neg.	Pos.	Neg.
open cct.	open cct.	35v	80v
shorted	open cct.	-	150v
50 ohms	50 ohms	10v	10v

Output circuitry and power supply introduce no duty cycle limitation. Amplitude is continuously variable over a 10:1 range. Connectors are UHF type (SO239).

*Stability is stated as typical change with line voltage variation of ±10v around 115v. Line voltage transients have negligible effect on pulse timing and amplitude.

1.6.2 Rise and Fall times (leading and trailing edge transition times between 10% and 90% amplitude points).

Load		Rise Time (Nanosec)		Fall Time (Nanosec)	
Pos.		Pos.	Neg.	Pos.	Neg.
open cct.	open cct.	30	120	80	200
shorted	open cct.	-	50	-	200
50 ohms	50 ohms	30	30	40	40

1.6.3 Waveform (with load impedance of 50 ohms or more)

Overshoot is adjustable to less than 5%. Positive pulse top slope is less than 3% for durations less than 10,000 μsec (6% at 100 millisec). Negative pulse top slope is less than 3% for durations less than 2000 μsec (20% at 100 millisec with 50 ohm load, less with higher impedance load).

1.7 SYNC OUTPUT

Provides positive 20v from 100 ohm source, approximately 150 nanosec duration, ac coupled; negative 5v from 220 ohms, 0.35 μsec duration, ac coupled.

1.8 POWER REQUIRED

105-125v, 50/60 cycle ac, approximately 110 watts. 230v, 50/60 cycle operation is available at slight extra cost.

1.9 CONSTRUCTION

Light gold anodized front panel, beige one-piece portable cabinet. Signal connectors are five-way binding posts unless otherwise noted.

1.10 SIZE AND WEIGHT

9" H x 8-1/8" W x 13" D. Weight is approximately 16 lbs.

1.11 ACCESSORIES FURNISHED

One operation and maintenance manual.

1.12 ACCESSORIES AVAILABLE

Coaxial cables, 50 ohm power termination (Type 2002); trigger pulse inverting transformers (Type 2101).

SECTION II

OPERATING INSTRUCTIONS

2.1 DESCRIPTION OF CONTROLS AND CONNECTORS

See Figures 2-2 and 2-3.

2.1.1 Power On-Off

The line power applied to the instrument is controlled by this toggle switch.

2.1.2 Pilot

The red indicator is illuminated when the power in ON.

2.1.3 Repetition Rate

The lower knob selects the range of pulse repetition frequency. There are six decade ranges. The EXT. position permits external triggering.

2.1.4 Repetition Rate Vernier

The upper control provides 210° of continuously variable fill-in between the ranges of the REPETITION RATE control.

2.1.5 Positive External Trigger Input

This jack accepts a 15v pulse to slave the generator when the REPETITION RATE control is on the EXT. position.

2.1.6 Positive Sync Output

This jack couples out a positive pulse which serves as a zero time reference for the main pulse delay.

2.1.7 Negative Sync Output

This jack couples out a negative pulse which serves as a zero time pulse for the main pulse delay.

2.1.8 Pulse Delay

The lower control selects the range of pulse delay. There are six decade ranges.

2.1.9 Pulse Delay Vernier

The upper knob provides 270° of continuously variable fill-in between the ranges of the PULSE DELAY control.

2.1.10 Pulse Width

The lower control selects the range of pulse width. There are six decade ranges.

2.1.11 Pulse Width Vernier

The upper knob provides 270° of continuously variable fill-in between the ranges of the PULSE WIDTH control.

2.1.12 Overshoot

This knurled fingertip adjustment permits fine trimming of the waveform which is necessary under some loading situations.

2.1.13 Amplitude

This knob has simultaneous control over the two output amplitudes.

2.1.14 Positive Pulse Output

This UHF connector direct couples out the main positive output pulse.

2.1.15 Negative Pulse Output

The UHF connector ac couples out the main negative output pulse.

2.1.16 Fuse (located on rear panel)

A 2-ampere fast acting fuse protects the instrument against ac overload.

2.2 PLACING IN OPERATION

2.2.1 Preliminary Settings

a. REPETITION RATE control to X10^3, REPETITION RATE VERNIER clockwise (ccw).

b. PULSE DELAY control to X0.1, PULSE DELAY VERNIER to 5 MICROSECONDS.

c. PULSE WIDTH control to X0.1, PULSE WIDTH VERNIER cw.

d. AMPLITUDE control cw.

2.2.2 Set POWER switch to ON. PILOT should light.

2.2.3 Sync scope from POSITIVE SYNC OUTPUT. Set scope sweep speed to 0.2 μs/cm; set vertical sensitivity to 20v/cm.

2.2.4 Observe the output pulse against that shown in Figure 2-1. Refer to the Troubleshooting Procedure, paragraph 4.2, if the unit does not function properly.

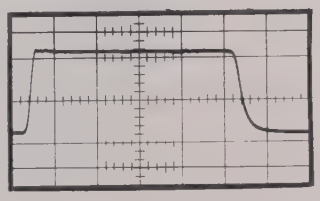


Figure 2-1 Output Pulse
1.0 Microsec Wide
Viewed on Tektronix Type 541 Oscilloscope

2.3 OPERATING CONSIDERATIONS

2.3.1 External Triggering

REPETITION RATE control must be on EXT. Maximum repetition rate is 1 mc.

Figure 2-2 Front Panel Controls.

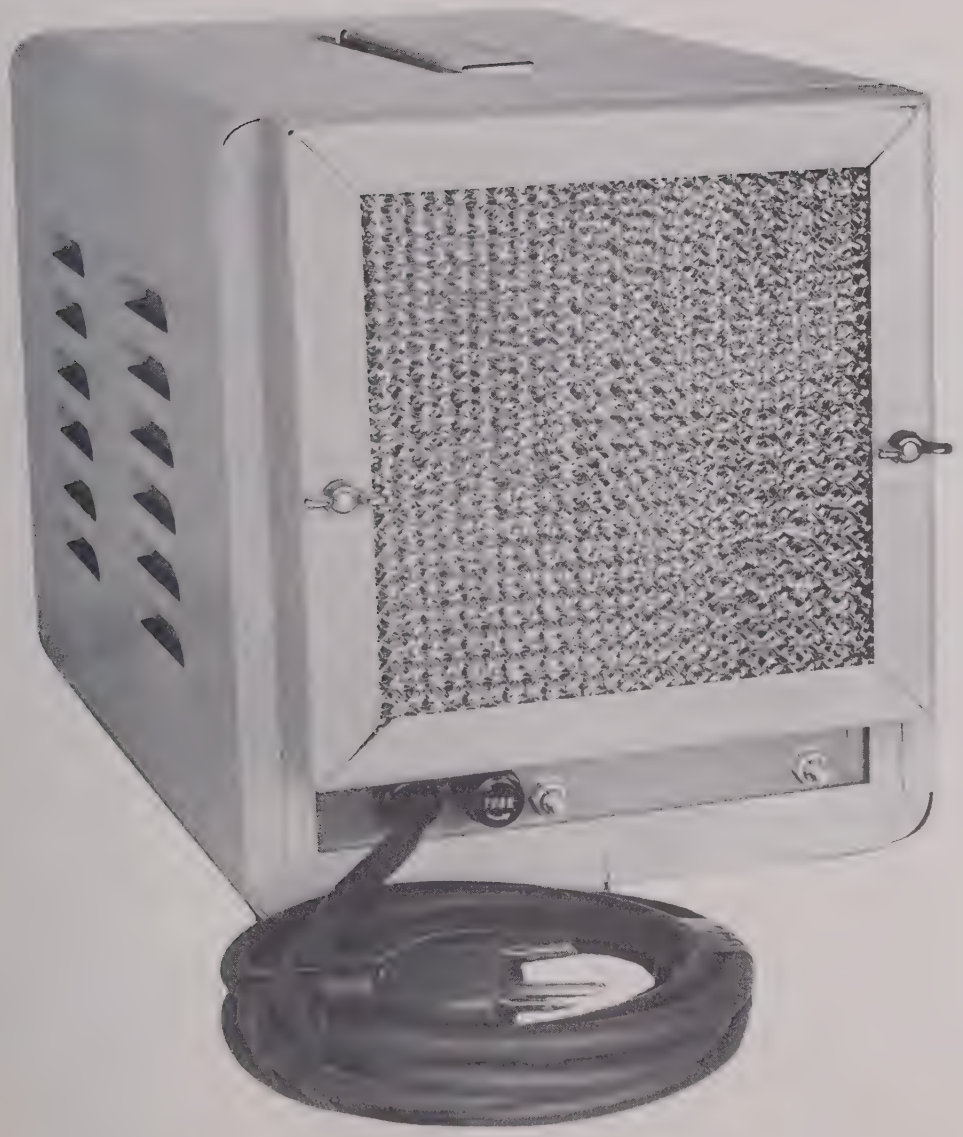


Figure 2-3 Instrument Rear.

2.3.2 Delay Duty Cycle

Delay circuits may fail at PULSE DELAY control settings greater than 80% of the main pulse period.

2.3.3 Pulse Width Duty Cycle

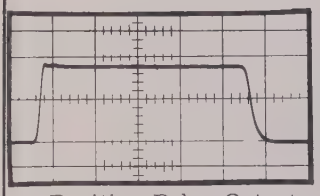
Pulse width circuits may fail at PULSE WIDTH control settings greater than 80% of the main frequency. There is no average current or average power limitations which would pose restrictions on pulse width duty cycle. There is some output amplitude limiting with width duty cycle.

2.3.4 Cooling

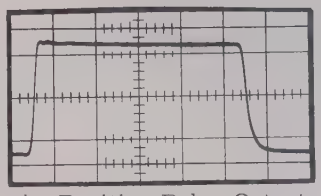
Maintain a clearance of at least three inches at the back of the rear air intake, and be sure to clean the air filter at regular intervals. Adequate cooling is the major factor in tube life and instrument reliability.

2.3.5 Output Pulse Characteristics

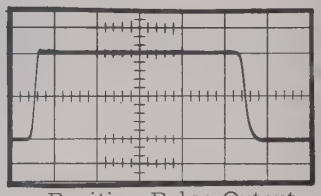
In order to realize the full capability of your Model 100 it is necessary to have some understanding of its output characteristics. Table I indicates the typical performance that may be expected while Figure 2-4 provides an illustrative sampling of the capabilities.



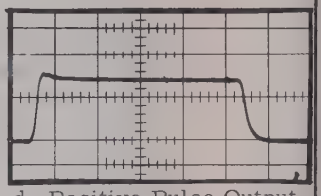
a. Positive Pulse Output Open Circuit -- Negative Jack Terminated in 50Ω -- 20v/cm.



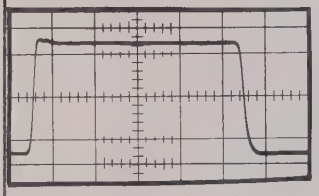
b. Positive Pulse Output into 100Ω Load -- Negative Jack Unterminated -- 5v/cm.



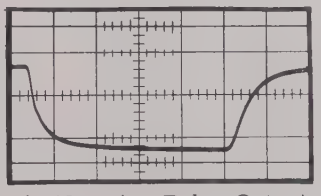
c. Positive Pulse Output into 100Ω Load -- Negative Jack Shorted to Ground -- 10v/cm.



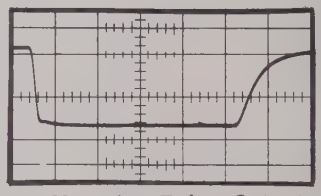
d. Positive Pulse Output into 50Ω Load -- Negative Jack Unterminated -- 5v/cm.



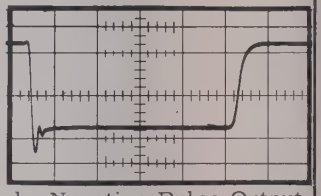
e. Positive Pulse Output into 50Ω Load -- Negative Jack Shorted to Ground -- 5v/cm.



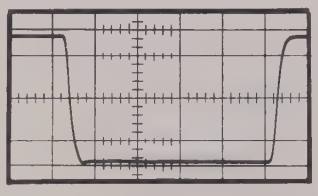
f. Negative Pulse Output Open Circuit -- Positive Jack Unterminated -- 50v/cm.



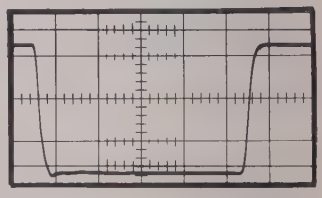
g. Negative Pulse Output Open Circuit -- Positive Jack Terminated in 50Ω -- 100v/cm.



h. Negative Pulse Output into 50Ω -- Positive Jack Unterminated -- 2v/cm.



i. Negative Pulse Output into 100Ω -- Positive Jack Shorted to Ground -- 10v/cm.



j. Negative Pulse Output into 50Ω -- Positive Jack Shorted to Ground -- 5v/cm.

Figure 2-4. Output Pulse Viewed on Tektronix Type 541 Oscilloscope with Type L Preamplifier. Sweep Speed: .2μs/cm

TABLE I

OUTPUT PULSE CHARACTERISTICS

AMPLITUDE (VOLTS)

POSITIVE PULSE AMPLITUDE			
NEGATIVE JACK	OPEN CIRCUIT	100Ω	50Ω
Unterminated	40	13	7
50Ω Term.	40	18	10
Shorted	40	18	10

NEGATIVE PULSE AMPLITUDE			
POSITIVE JACK	OPEN CIRCUIT	100Ω	50Ω
Unterminated	95	7	4
50Ω Term.	190	22	11
Shorted	190	26	13

These voltages were measured at 50 kc with 1 microsec delay and 1 microsec width and may be considered typical.

RISETIME (NANOSECONDS)

POSITIVE PULSE RISETIME			
NEGATIVE JACK	OPEN CIRCUIT	100Ω	50Ω
Unterminated	26	26	26
50Ω Term.	25	25	26
Shorted	25	25	26

NEGATIVE PULSE RISETIME			
POSITIVE JACK	OPEN CIRCUIT	100Ω	50Ω
Unterminated	200	--	--
50Ω Term.	36	25	25
Shorted	26	50	35

Measured on Hewlett Packard 185 Sampling Oscilloscope and may be considered typical.

OUTPUT PULSE CHARACTERISTIC SUMMARY

For Pos. Pulse	For Neg. Pulse	For Pos. & Neg. Simultaneously
Optimum waveform and maximum power is achieved by shorting the negative output jack.	Optimum waveform is obtained by terminating the positive terminal in 50 ohms. Maximum power is delivered by shorting the positive output terminal to ground.	Best performance is obtained by terminating both outputs into like loads.

Note: Terminate the negative output into 100 ohms or less if fast rise times are desired.

Very large amplitudes may be obtained from the negative jack with light loads and with the positive jack shorted.

The source impedance of the positive output may be decreased by decreasing the negative jack termination resistance.

When the positive jack is unterminated, the negative pulse waveform has excessive overshoot when delivering power into low impedance loads.

2.3.6 Amplitude Stability

In that the plate supply voltage for the output amplifier tube is not line voltage regulated, some pulse amplitude variation may be expected. It is typical for the amplitude to vary less than ±5% for a line voltage variation of ±10v around 115v. This is true for all output jack loading combinations except when the positive pulse is terminated by 50 ohms and the negative terminal is open circuit, or for unterminated negative pulse outputs. Amplitude excursions of less than ±10% is then characteristic.

2.3.7 Overshoot

Because of the manner in which the pulse is formed, i.e., by blending a fast trigger with a gate, it is occasionally necessary to readjust the OVERSHOOT control in order to optimize the waveform. In general, it is desirable to set the OVERSHOOT control with an oscilloscope for each different pulse loading situation. It is usually necessary to crank in more "overshoot" for very high pulse width duty cycles, to turn down the overshoot at high line voltages, and it is often necessary to readjust the overshoot control at reduced amplitudes.

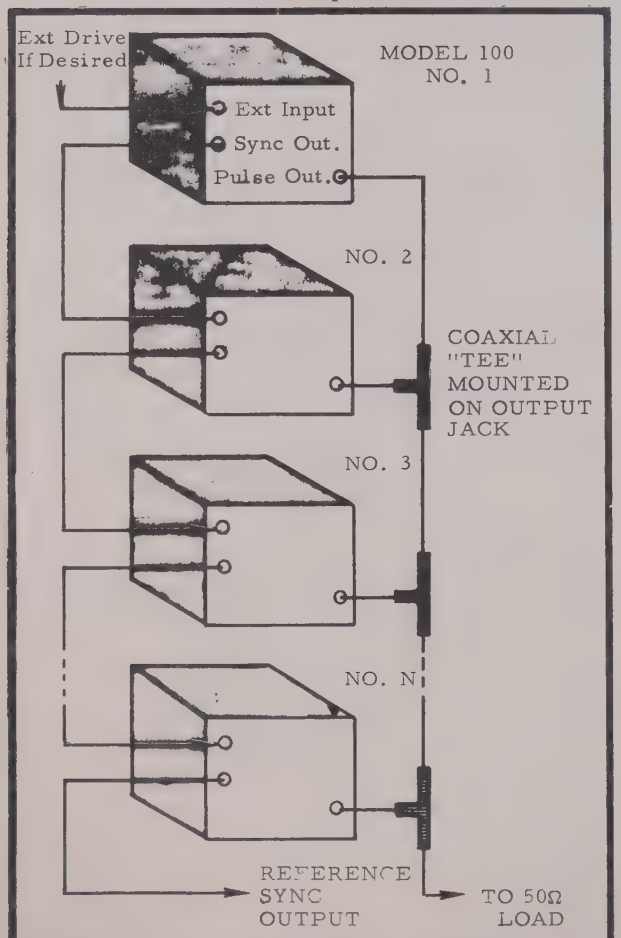


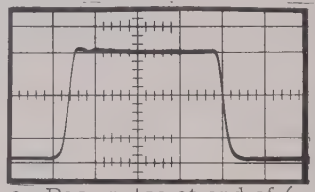
Figure 2-5. Wiring for Multiple Pulse Output. Note, that sync occurs approx. 18 nanoseconds after external trigger. Reference Sync occurs N x 18 nanoseconds if N equals the number of generators.

2.3.8 Multiple Pulse or Pulse Train Operation Using Several Model 100's

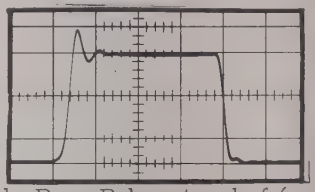
Magnetic device testing, beacon development, and digital or other pulse code simulation often require multiple pulse or pulse train signals. Multiple DATAPULSE 100 Pulse Generators, when properly connected, will satisfy a broad range of requirements of this type.

Mixing the outputs of several 100's, instead of purchasing a special purpose multi-pulse generator, offers many advantages. First, pulse parameters may be controlled individually; second, all pulses are selectable in polarity -- a feature not always available on multi-pulse generators; third, average power is greater than in most special units; fourth, such an arrangement is more versatile since the individual units may be broken down for use on other projects; and fifth, the combination of simple, proven, easily operated 100's is more dependable than complex special gear.

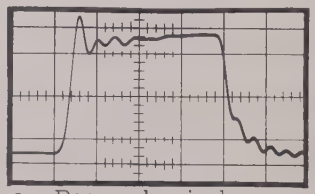
The 100's may be driven in parallel from an external source, if sync with outside phenomena is desired, or driven in tandem (see Figure 2-5) using the sync output of one generator to externally drive the next. The first generator may be driven from an external source in the tandem arrangement also.



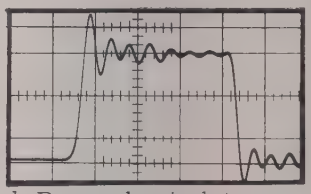
a. Pos. pulse at end of 6-ft. RG58A/U cable terminated in 50Ω at end opposite generator. 0.1 μs/cm. (Good Technique)



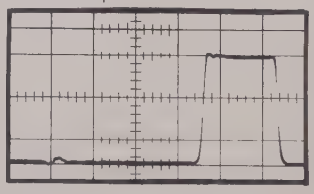
b. Pos. Pulse at end of 6-ft. RG58A/U cable terminated in 50Ω at generator. 0.1 μs/cm.



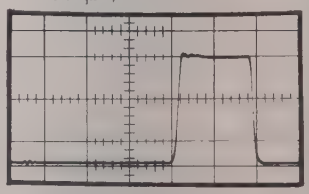
c. Pos. pulse jack connected to the scope with clip lead. 50Ω load located at scope. 0.1 μs/cm



d. Pos. pulse jack terminated in 50Ω at generator connected to scope with clip lead. 0.1 μs/cm



e. Pos. pulse where POS SYNC OUTPUT is connected to scope with clip lead. Note baseline preceding pulse. 0.2 μs/cm

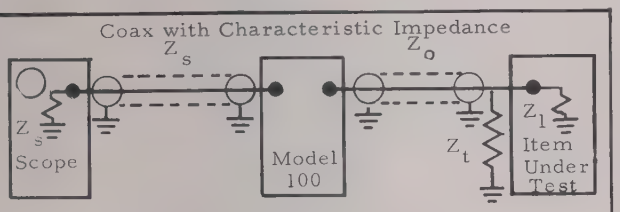


f. Pos. pulse output where POS SYNC OUTPUT is connected to scope with 4-ft. RG62/U cable terminated in 93Ω at scope. 0.2 μs/cm.

Figure 2-6. Cabling and Connection Effects Viewed with Tektronix 541 Oscilloscope. 5v/cm.

2.3.9 Cabling Considerations

Preservation of high fidelity waveforms is largely contingent upon the manner in which the pulse generator is connected to whatever it is driving and how it is connected to the scope. Clean waveforms are sustained by connecting the generator to its load with coaxial cable and by terminating the coax at the load in the characteristic impedance of the cable. The same is true of the sync connection to the scope. Figure 2-6 illustrates the effect of poor cabling. Figure 2-7 illustrates proper cabling. Connect the generator to the scope with coaxial cable and then terminate the coax at the scope in the characteristic impedance of the coax.



Z_t = termination impedance

Z_l = input impedance of device under test

Z_s = sync cable coax impedance

Z_o = output cable coax impedance

$$Z_t = \frac{Z_o Z_l}{Z_l - Z_o}$$

Figure 2-7. Proper Cabling Connection

2.3.10 Wide Pulse Operation

If it is necessary to preserve a flat pulse top under wide pulse situations, knowledge of the following characteristics will be useful.

a. The positive pulse has less top slope than the negative.

b. Top slope is load dependent. Light loads have negligible degenerative effect on slope.

c. Less slope is observed by leaving the circuit open on the opposite polarity jack.

d. Higher duty cycles increase top slope somewhat.

2.3.11 Notch Adjust (Refer to Figure 2-8).

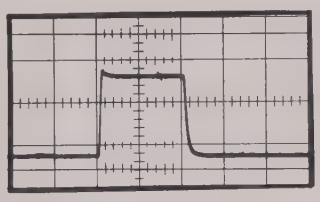
Trimmer C35 permits some control of the pulse waveform immediately after the leading edge. This trimmer is accessible through the plastic grommet on the right hand side of the instrument. The optimum setting for delivering pulses into high impedance loads is different from that best setting for 50 ohm loads. In general, more capacity is required for the high impedance loads and less capacity for the lower impedance.

2.3.12 Negative Output Jack

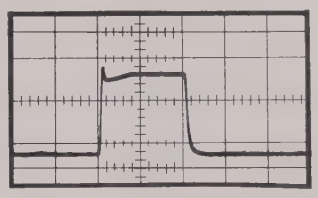
CAUTION

Care should be exercised in making cable connections and in connecting the termination resistors to the NEGATIVE OUTPUT jack.

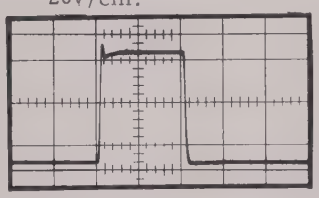
The amplitude of the signal at this point is large enough to be dangerous.



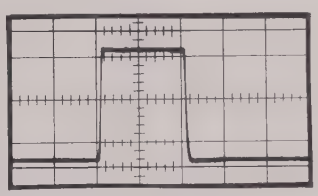
a. Positive Output Pulse Open Circuit -- Negative Jack Unterminated. C35 is properly compensated. 20v/cm.



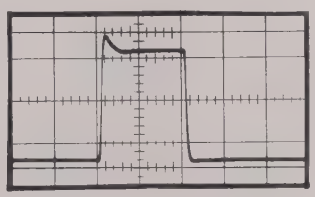
b. Positive Output Pulse Open Circuit -- Negative Jack Unterminated. C35 is undercompensated. 20v/cm.



c. Positive Output into 50Ω -- Negative Jack Terminated in 50Ω. C35 is undercompensated. 5v/cm.



d. Positive Output into 50Ω -- Negative Jack Terminated in 50Ω. C35 is properly compensated. 5v/cm.



e. Positive Pulse into 50Ω -- Negative Jack Terminated in 50Ω. C35 is overcompensated. 5v/cm

Figure 2-8. Notch Adjust Considerations Viewed on Tektronix 543 with Sweep Speed at .5μs/cm.

SECTION III

THEORY OF OPERATION

3.1 BLOCK DIAGRAM DESCRIPTION

W numbers used below correspond to numbered waveforms on the block diagram (Figure 3-2) and to physical test points on the printed circuit board shown in Figure 3-3.

V numbers correspond to tube numbers on the schematic (Drawing No. J40000-026).

The pulse repetition rate is generated by the Oscillator. Its output (W1) is differentiated and the positive going portion is shaped by the "Sync Trigger Amplifier" to form a fast trigger (W2). This signal (W2) is buffered in the "Sync Cathode Follower" which provides the positive sync output. The sync signal (W2) also triggers the "Delay Multivibrator". The output of this circuit is a negative gate (W3) which is differentiated and the positive going portion is amplified by the "Delay Blocking Oscillator". The large signal (W4) from this blocking oscillator is attenuated somewhat and used to trigger the "Width Multivibrator". This circuit is identical to the "Delay Multivibrator" circuit.

The high amplitude trigger (W4) is applied to the pulse forming network to form a fast rise time leading edge on the main pulse. The negative gate (W5) from the "Width Multivibrator" is also applied to the "Pulse Forming Circuit" to sustain the pulse after the leading edge has subsided. The "Pulse Forming Circuit" yields a high amplitude fast rise time gate (W6) which is condenser coupled to the "Output Amplifier" where it is transferred into a moderate power pulse.

3.2 CIRCUIT DESCRIPTIONS

3.2.1 Astable Schmidt Trigger

The Astable Schmidt trigger circuit differs from a normal Schmidt trigger in that the charging network C_t and R_t (see Figure 3-1) produces a controlled positive going waveform on the grid (pin 2) of the trigger tube. This circuit functions as follows: V1B conducts heavily because of the bias imposed upon it by R5, R6 and R10 between B+ and B-. The current of V1B flows through R_k causing a large voltage drop which appears as a positive potential at the common cathode pins 3 and 8. As the grid (pin 2) of V1A is around ground V1A is cut off by the positive potential at its cathode (pin 3). At a time (t), C_t begins to charge through R_t toward B+. This charge continues until time (t2) when the grid-to-cathode voltage of V1A is small enough to allow conduction. As V1A conducts, its plate (pin 1) dips sharply because of current flowing through R5 (15k). This negative going potential is coupled across R6 (22k) and C7 (27 $\mu\mu$f) to the grid of V1B (pin 7). The conduction of V1B now decreases, decreasing the cathode potential of V1A causing V1A to conduct harder and thus regeneratively saturate itself and cut off V1B.

Because R5 is 15k and R9 only 1k, much less current flows through Rk as V1B cuts off and its cathode potential approaches ground. The grid of V1A (pin 2) follows the cathode down, discharging C_t through grid current. At a time (t3), a point around ground is reached where the cathode to grid potential is low enough for V1B to conduct.

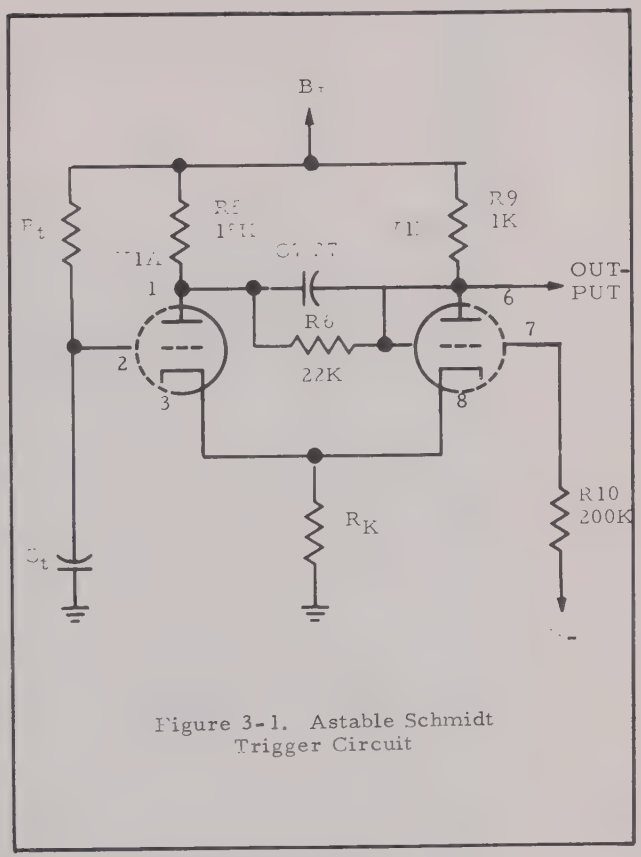


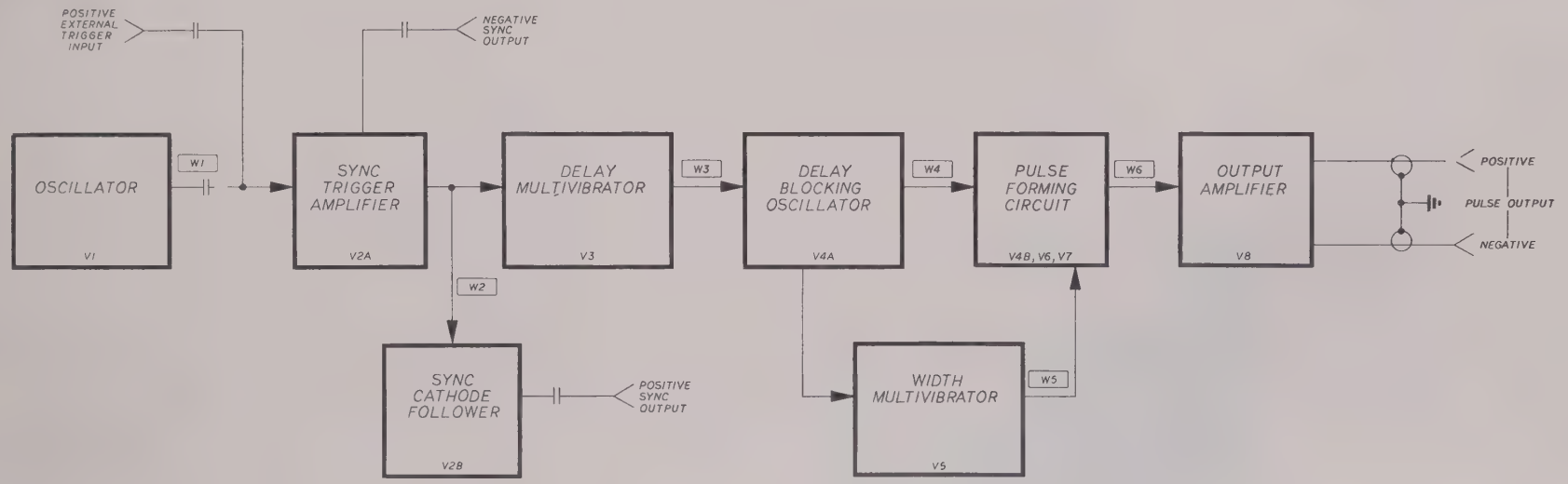
Figure 3-1. Astable Schmidt Trigger Circuit

An attendant increase of current through Rk causes a higher potential at the cathode of V1A (pin 3). As V1A decreases conduction and its plate (pin 1) becomes more positive, this waveform coupled across R6 and C7 to the grid of V1B (pin 7) causes V1B to conduct harder with an attendant increase of current through Rk which regeneratively saturates V1B and cuts off V1A. C_t now begins to charge through R_t toward B+ and the cycle is repeated.

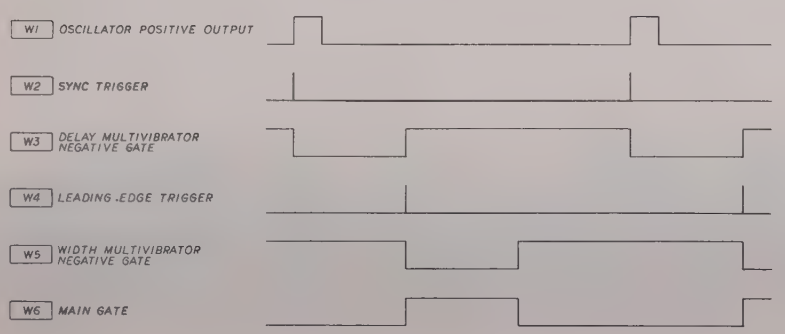
The output of this circuit is taken from the plate of V1B (pin 6) and is used to trigger the Sync Trigger Amplifier (V2).

3.2.2 Trigger Amplifier

Initially, the tube is cut off because of bias return. As a positive pulse is applied to the grid, the plate conducts heavily and goes negative. The polarity of the transformer is such that a negative charge upon the plate provides a positive going signal to the grid of the next tube. Pulse narrowing takes place (see Figure 3-6) because the tube only conducts when the pulse is above the cutoff point;



TIMING SEQUENCE



REVISIONS

E.C.R.	SYM	DESCRIPTION	DATE	APPROVAL

LIST OF MATERIALS

REQD	PART NO.	DESCRIPTION	ITEM

UNLESS OTHERWISE SPECIFIED
DIMENSIONS ARE IN INCHES
TOLERANCES ON
3 PLACE DEC. ± | 2 PLACE DEC. ± | ANGLES ±
MATERIAL
FINISH
DO NOT SCALE DWG.

DRAWN	B BUSICK	18 JUN 62
CHECKED	R.H.B.	18 JUN 62
APPROVED		21 JUN 62
APPROVED		21 JUN 62
APPROVED		
RELEASED	B BUSICK	22 JUN 62

NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
APPLICATION		QTY REQD	

TITLE
BLOCK DIAGRAM—
PULSE GENERATOR
MODEL 100

SCALE NONE

DATAPULSE
DATAPULSE INC.
INGLEWOOD CALIFORNIA

DWG NO. 41000-010
SIZE D
SHEET 1 OF 1

41000-010

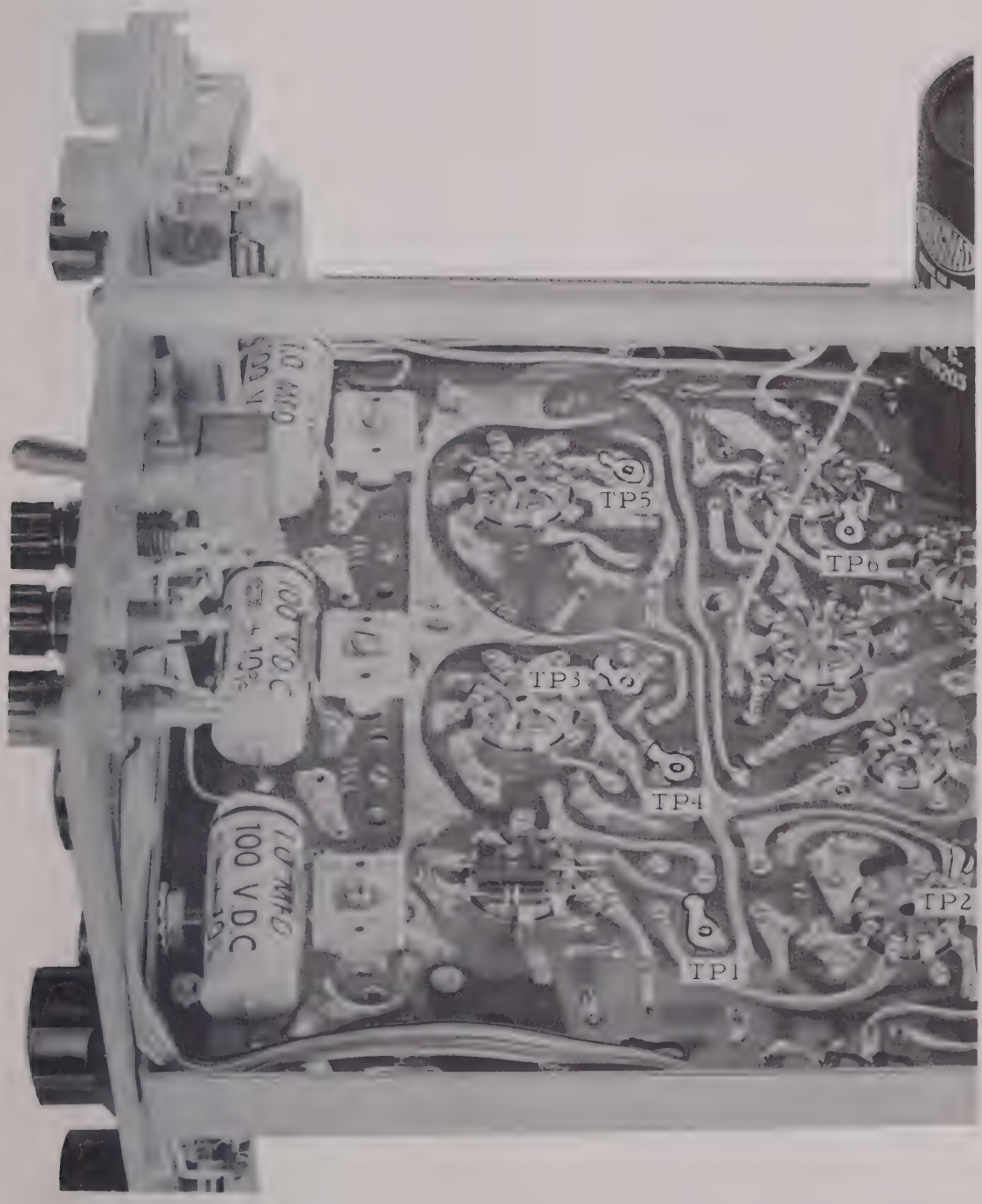
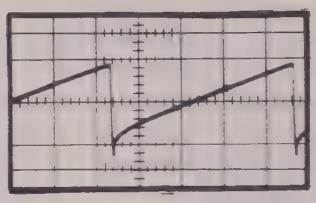
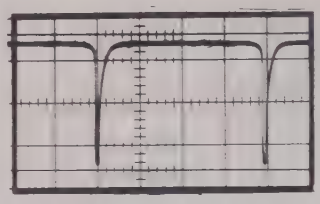


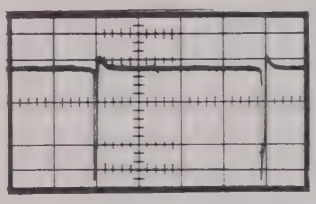
Figure 3-3. Signal Test Points.



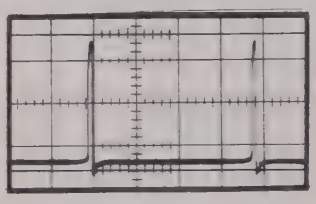
a. Pin 2V1, 5v/cm



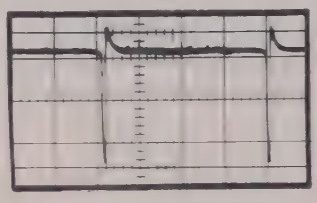
b. Pin 1V1, 20v/cm



c. Pin 7V1, 10v/cm



d. Pin 6V1, 10v/cm



e. Pin 3 & 8V1, 5v/cm

Figure 3-4. Oscillator Timing. Viewed on Tektronix 541 at 50 kc Pulse Repetition Frequency. Sweep Speed: 5μs/cm

thus, the time from the baseline to approximately the 85% amplitude point is eliminated.

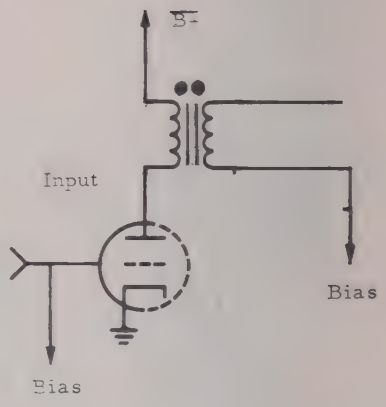
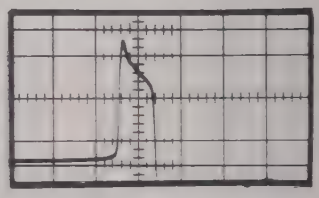
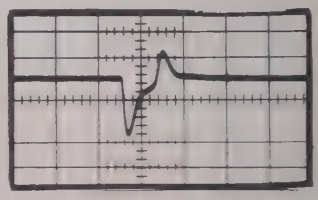


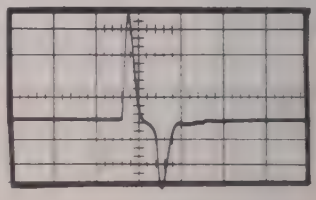
Figure 3-5. Trigger Amplifier



a. Pin 7V2, 5v/cm



b. Pin 6V2, 50v/cm



c. T1 Output, 20v/cm

Figure 3-6. Trigger Amplifier Waveform. Viewed on Tektronix 541. 50KC Repetition Rate. Sweep Speed 0.5μs/cm

3.2.3 The One Shot Multivibrator

The pulse delay circuitry is a cathode coupled one shot multivibrator. Since pulse width generation is essentially a delay function, (i.e., the delay of trailing edge with respect to leading edge) the same technique is used to perform both operations. For this reason only delay shall be discussed.

In the quiescent state, V3B is cut off because of the bias imposed upon its grid (pin 7) by the voltage divider composed of R19, R20, R21 and R25. V3A is conducting because of its positive grid return through R_t. As the plate load R19 is great (100k) with respect to Rk, the common cathodes of V3A and V3B are at a potential around ground. At time (t0) a positive input trigger causes V3B to conduct and because of the low impedance (1k) in the plate of V3B (pin 6) a large current flows through Rk causing the cathode of V3A (pin 3) to become sufficiently positive to cut off V3A. As the plate (pin 1) of V3A becomes more positive, because of decreased current flow, this waveform is coupled across C20-R20 and C21-R21 to the grid of V3B causing more current to flow, regeneratively saturating V3B.

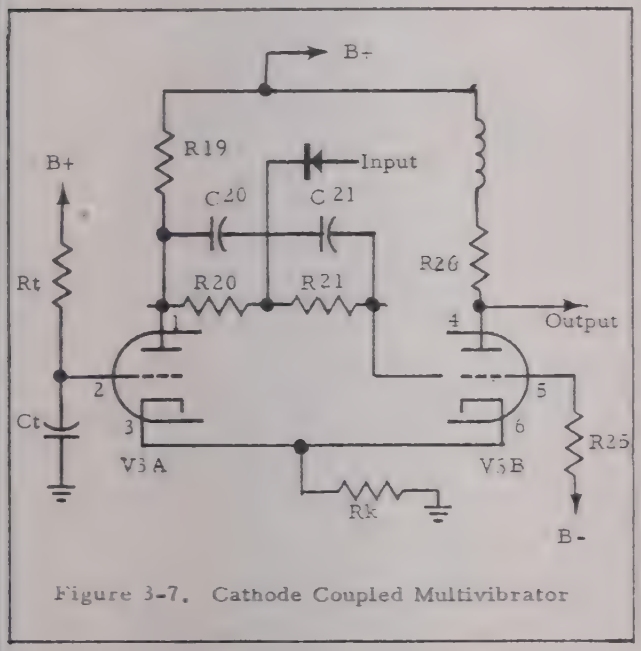
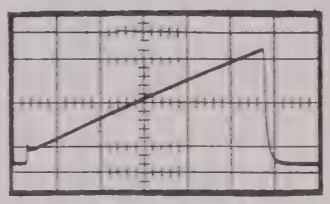
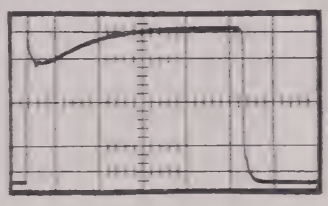


Figure 3-7. Cathode Coupled Multivibrator

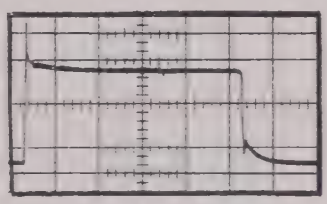
As soon as the cathode of V3A (pin 3) becomes more positive than its grid (pin 2) C_t begins to charge through R_t. This charge continues until a point is reached at time (t2) when the grid of V3A (pin 2) is sufficiently positive to allow V3B to again conduct driving its plate (pin 1) negative. This negative waveform coupled across C20-R20 and C21-R21 to the grid of V3B (pin 7) causes conduction of V3B to decrease, forcing the cathode of V3A less positive and increasing conduction, regeneratively saturating V3A and cutting off V3B. The cathodes of V3A and V3B return to their quiescent state and the grid of V3A follows the cathodes down as grid current discharges C_t completing the cycle.



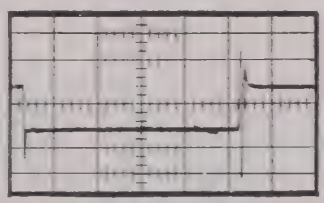
a. Pin 2V3, 5v/cm



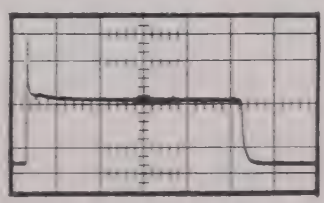
b. Pin 1V3, 10v/cm



c. Pin 7V3, 10v/cm



d. Pin 6V3, 20v/cm



e. Pins 3, 8V3, 10v/cm

Figure 3-8. Delay and Width Circuit Waveforms. Viewed on Tektronix Type 541 Oscilloscope. Sweep Speed 2μs/cm

3.2.4 Blocking Oscillator

The tube V4A is normally cut off due to the bias on its grid (pin 7). Its input is the differentiated gate output of the delay multivibrator.

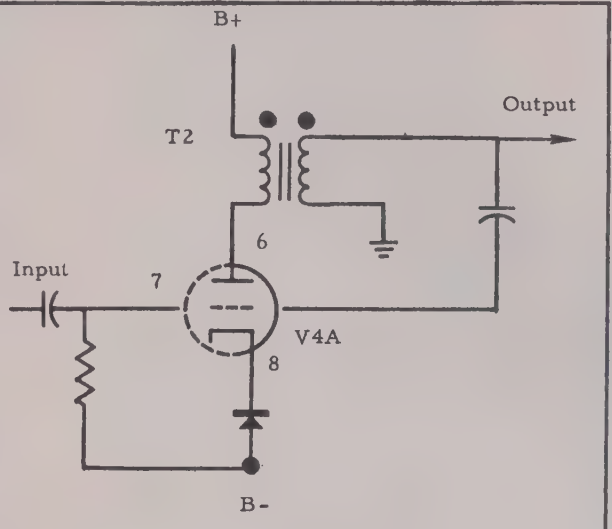
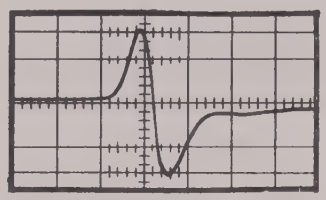
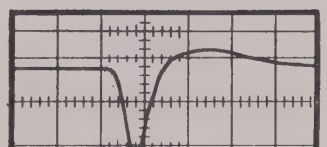


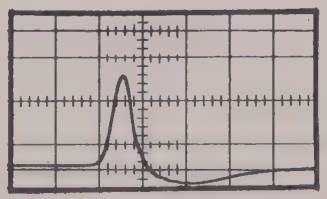
Figure 3-9. Blocking Oscillator



a. Input, Pin 7V4A, 20v/cm



b. Plate, Pin 6V4A, 50v/cm



c. Output, T2 secondary, 50v/cm

Figure 3-10. Blocking Oscillator Waveforms. Viewed on Tektronix Type 541 Oscilloscope Scope Sweep Speed -- 0.1μs/cm

The negative going portion just drives the grid farther below cutoff while the positive going portion causes plate conduction to commence. As plate current increases the voltage on the plate drops rapidly. The drop in plate voltage causes an increase in grid voltage (via the inverting transformer T2 and C24) resulting in even larger plate currents. This regenerative action continues until it is limited by the non-linearity of the tube. At the pulse peak, grid current causes the grid to go negative with respect to the cathode, resulting in a decrease in plate current and an increase in plate voltage.

3.2.5 Pulse Forming Circuits

V6A is normally conducting. Its plate (pin 9) sets slightly above ground. The negative duration gate applied at V6A (pin 7) cuts off V6A and its plate starts to rise at a rate determined by its plate circuit capacity. At the same time the leading edge trigger is applied to the "lift up diode" V4B.

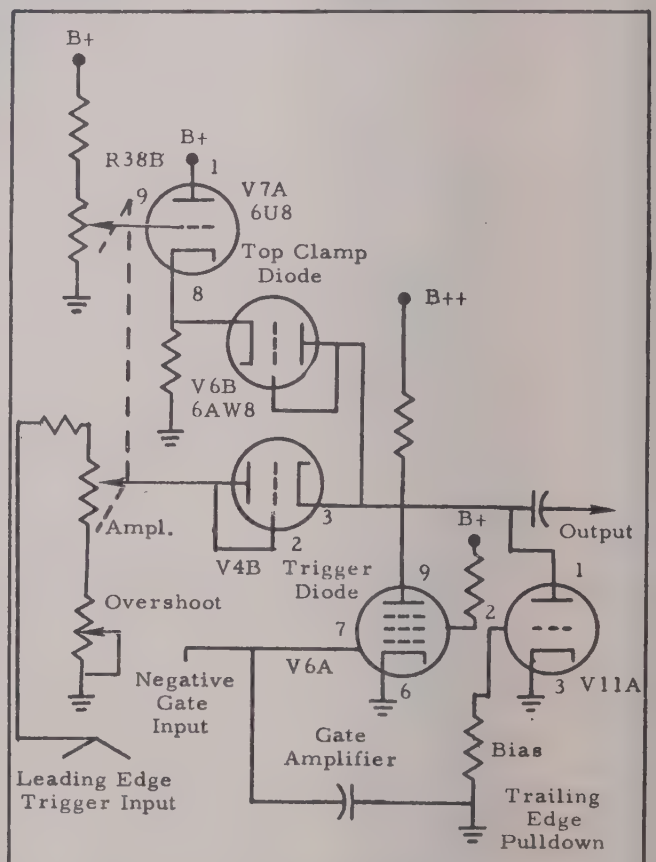
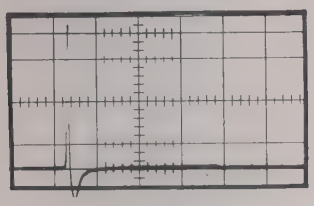


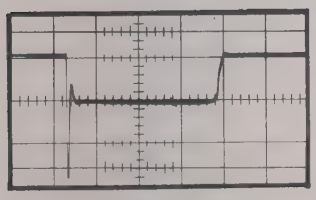
Figure 3-11. Pulse Forming Circuits

This low impedance trigger charges the plate circuit capacity of V6A very rapidly causing a fast rise time leading edge. The top of this fast rise time, high amplitude gate would be B++ (the plate supply voltage of V6A) were it not for the clipping action of V6B. However, the pulse top

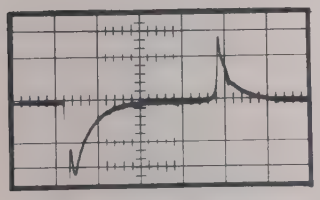
dc level is set by the amplitude control potentiometer which determines how much of the pulse top is to clipped. The negative gate from V5 is differentiated and the positive going portion is amplified by V11A, causing the trailing edge of the formed pulse to fall much faster than it would as a result of V6A being turned back on after the expiration of the negative gate from V5. Two components control pulse amplitude. R38A attenuates the trigger which forms the leading edge. This control is ganged with another which controls the pulse top level. Capacitor C35 couples-in a compensating signal to trim out a "notch" in the pulse top immediately following the leading edge.



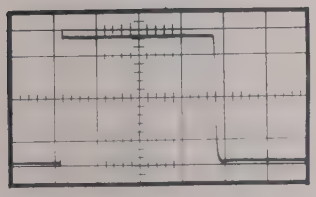
a. Pin 1V4, 20v/cm



b. Pin 7V6, .5v/cm



c. Pin 2V11, .5v/cm



d. TP6, 20v/cm

Figure 3-12. Pulse Forming Waveforms. Viewed on Tektronix Type 541 Oscilloscope. Sweep Speed: 1μs/cm

3.2.6 The Output Amplifier

The output amplifier is a paraphase amplifier. Positive pulses are direct-coupled from the cathode with the baseline at ground. Negative pulses are simultaneously ac-coupled from the plate. By shorting out the positive pulse output jack the circuit becomes a simple amplifier and large voltage gains are demonstrated. By shorting out the negative pulse output jack the circuit becomes a cathode follower and low source impedances are characteristic.

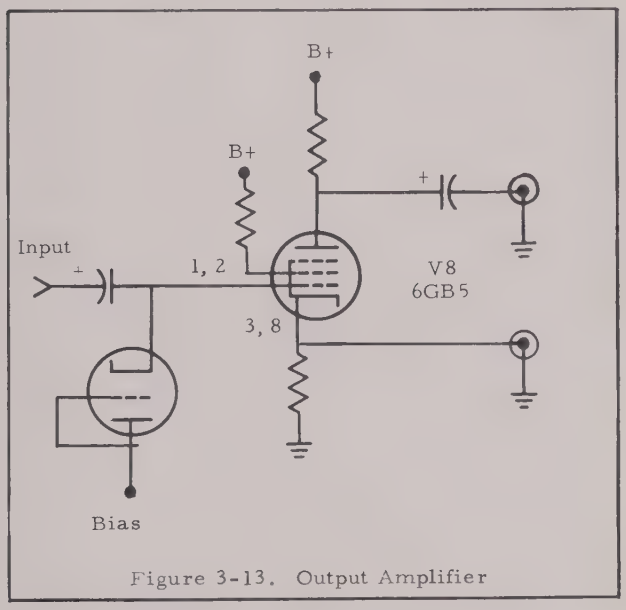
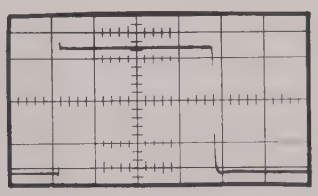
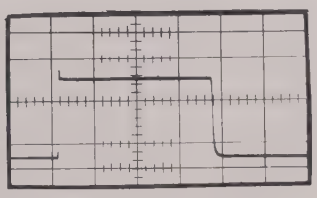


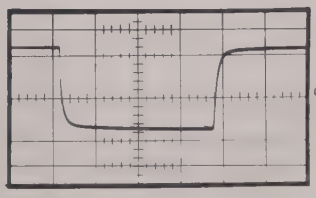
Figure 3-13. Output Amplifier



a. TP6, 20v/cm



b. Pins 3, 8V8, 20v/cm



c. Plate Cap V8, 50v/cm

Figure 3-14. Output Amplifier Waveforms. Viewed on Tektronix Type 541 Oscilloscope. Sweep Speed: 1μs/cm

MAINTENANCE INSTRUCTIONS

4.1 PREVENTIVE MAINTENANCE

4.1.1 Preventive Inspection and Service

Preventive inspection and service will insure optimum performance and add to life of this instrument. Remove chassis from the cabinet at regular intervals. Inspect for dust, tarnish, corrosion, loose nuts and bolts (especially those serving as electrical conductors), loose cables and fuses, charred insulation, scorched resistors and broken wiring. Discoloration of the printed circuit board, due to heat, does not affect the board's electrical properties and may be disregarded in most cases.

4.1.2 Minor Repairs

The operator should be thoroughly acquainted with the instrument's circuit theory and component location before attempting repair. In all cases, setting and adjustment of controls should be checked in order to verify that difficulties encountered are actually caused by malfunction and not by operation outside of specifications. Check tubes in suspected circuits prior to conducting extensive tests on other components. A check of the important waveforms brought out to the front panel will be of great assistance.

4.1.3 Recalibration

This instrument was designed to provide maximum reliability and stability. To insure that accuracy remains within stated limits, we suggest that calibration be checked after every 200 hours of operation. If the unit is used intermittently, calibration should be checked every three months. Complete instructions for calibration are given in this manual.

4.1.4 Filter Cleaning

The instrument is cooled by air drawn into the interior through a washable aluminum-mesh, adhesive coated filter. When dirty, the filter will restrict the flow of cooling air and cause overheating. To clean the filter, first rap it gently on a hard surface to remove loose dirt. Then wash the filter with hot water and soap. DO NOT USE CAUSTICS. After rinsing and drying, dip or spray the filter with an approved adhesive, such as FILTER-COAT manufactured by the Research Products Corporation of Madison, Wisconsin.

4.1.5 Fan Motor Lubrication

The fan motor should be lubricated at regular intervals with a few drops of light machine oil.

4.2 PARTS REMOVAL AND REPLACEMENT

4.2.1 General

This instrument is sturdily built and easily accessible. Removal of most parts is so simple that explanations are unnecessary. However, some parts are more easily removed if a definite procedure is followed. Replacement of some parts will also require partial recalibration. Refer to Section 4.4 of this manual for calibration instructions.

4.2.2 Removal of Chassis from Cabinet

See Figure 4-1. Remove the two screws on each side of the front panel, and the two screws on the rear of the cabinet. Push gently against the rear panel through the hole in the cabinet. As the front panel emerges from the cabinet the entire chassis assembly may be easily withdrawn by pulling it out.

4.2.3 Replacement of Timing Capacitors

These capacitors are mounted to the board in matched sets. Should a capacitor require replacing, its entire set (as indicated on the schematic) must be replaced with a new matched set. These matched condenser sets are available from DATA-PULSE. Recalibration is required if the condensers are replaced.

4.2.4 Replacing Tubes

Tubes should not be replaced unless they are actually causing trouble. Unnecessary replacement only necessitates recalibration. Tubes removed for maintenance reasons should be returned to the socket from which they were removed unless found to be defective. When replacement is necessary, only high quality tubes should be used.

4.2.5 Soldering Considerations

Although printed wiring is quite vulnerable to heat excesses, a great deal of resoldering can be done on a single joint if care is taken. A 35-watt wedge tip or pointed tip iron and 60-40 rosin core solder are quite effective. Where both sides of the board are accessible apply the tip of the iron (on the side opposite the component) directly to the solder fillet and pull gently on the pigtail with pliers from the opposite side. Where both sides of the circuit board are not accessible, the component lead will be fed through the board through an eyelet. Apply the iron tip to the eyelet and pull the pigtail out with the pliers. To insert a new component, clean out the hole with a sharp object (it may be necessary to apply more heat) and insert the new component, soldering in the old place.

4.3 TROUBLESHOOTING PROCEDURE

Before any troubleshooting is attempted the front panel controls should be checked for proper setting. You may wish to refer to Section 2.3 "Operating Considerations" which details many of the limitations of the instrument and describes the performance to be expected. After you have ascertained that a trouble does exist, you may continue according to the procedures outlined in this section. See Figure 4-3.

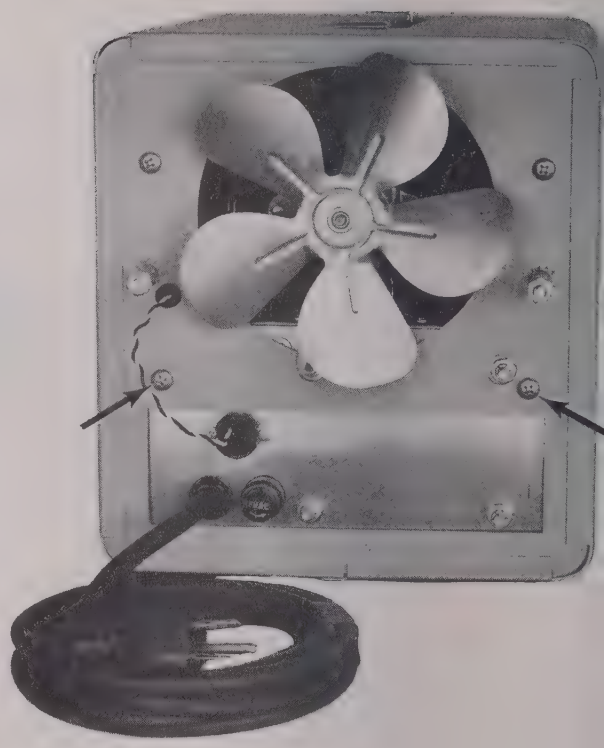
Many apparent malfunctions are due to improper calibration of one or more of the circuits, and often a tube is replaced, thus requiring recalibration. If you suspect that a circuit is miscalibrated, refer to Section 4.5 of this manual which describes a procedure for determining calibration status. Section 4.4 provides a detailed calibration procedure.

4.3.1 Troubleshooting the Power Supplies

Whenever trouble occurs check the power supply voltages. This test may be done by following Paragraph 4.4.2.1 of the "Calibration Procedure". It may be assumed that the power supplies are functioning properly if the output and ripple voltages are correct.

If the power supply is failing note that

1. The +105 regulator uses the -108v as a



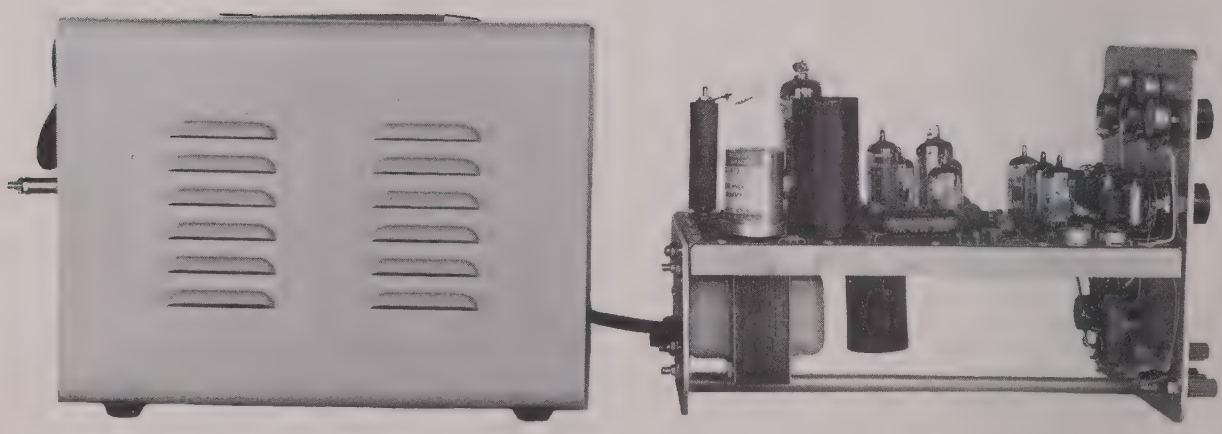


Figure 4-1. Chassis Removal.

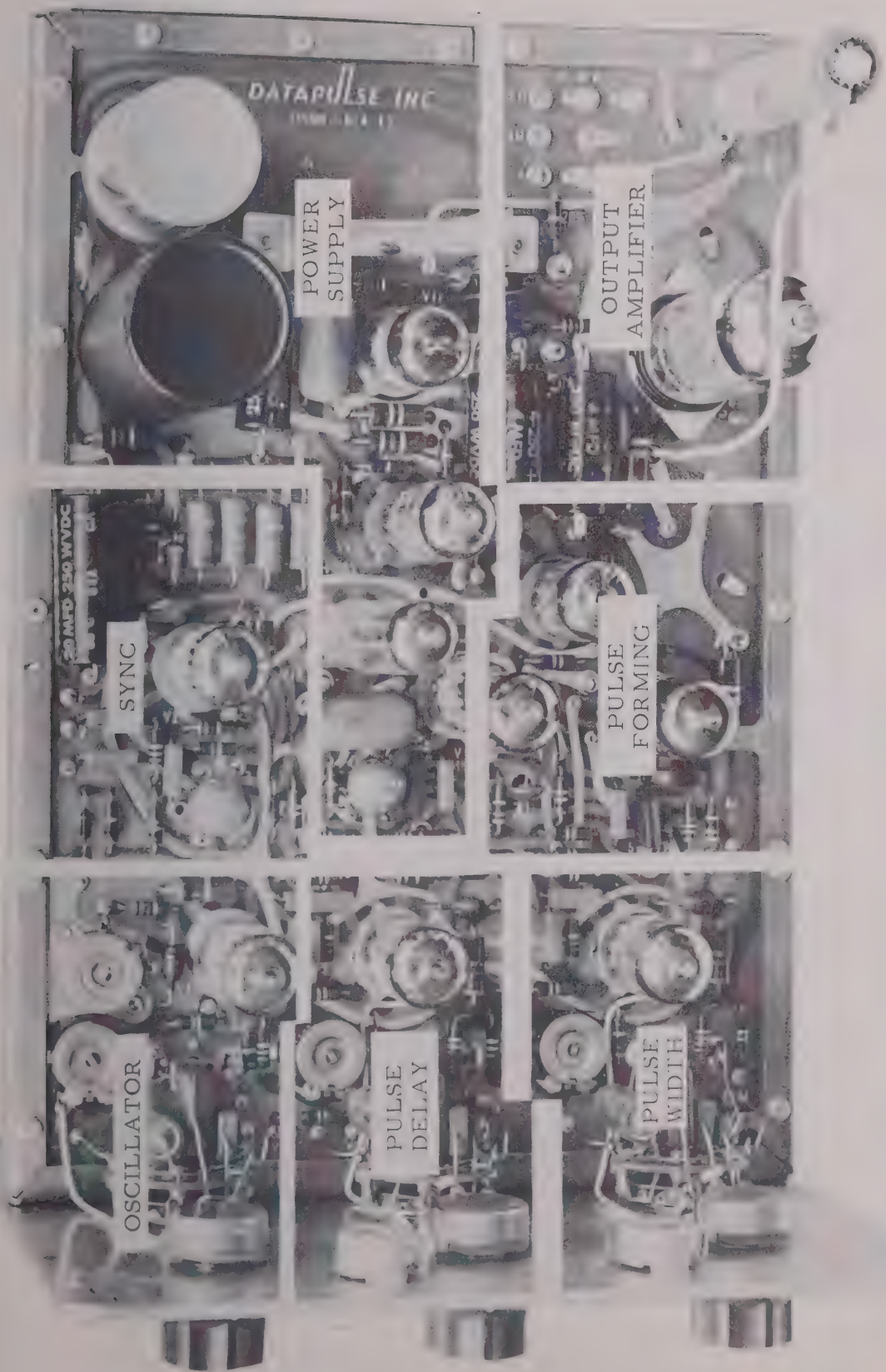


Figure 4-2. Circuits Location.

voltage reference. The -108v must be functioning correctly in order for the +105 to regulate.

2. The +250v is the plate supply for the +105v regulator and must be present in order for the +105 to be present.
3. Apparent failure of the 105v regulator is demonstrated both during overload and during underload situations.

4.3.2 Troubleshooting the Pulse Circuits

Figure 4-3 shows some of the plausible symptoms exhibited during malfunction and indicates the circuits that might be suspected. Figure 4-4 depicts many of the output pulse waveforms possible due to circuit failure and relates these waveforms to specific circuits. This set of waveforms was obtained by removing tubes. Weak tubes would have an intermediate effect.

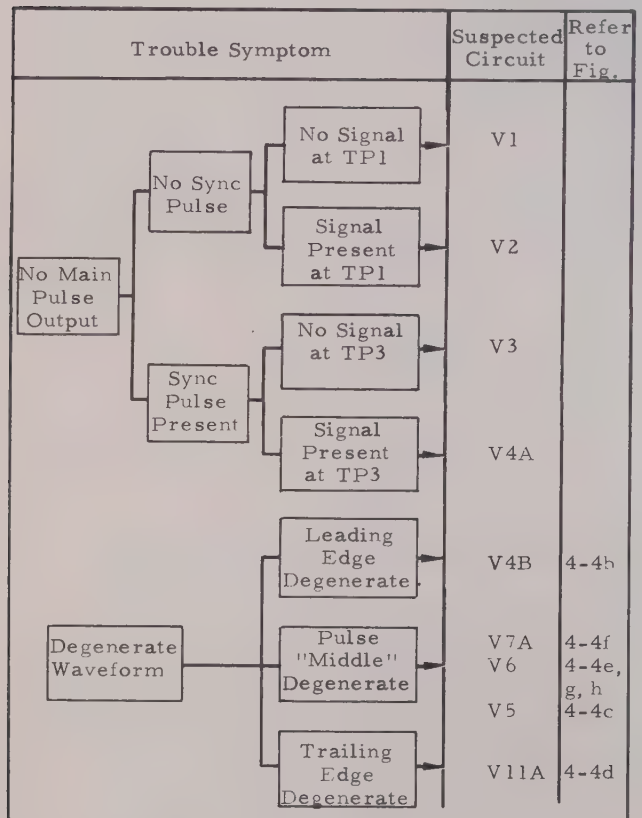


Figure 4-3
Troubleshooting by Signal Tracing

When malfunction can be attributed to a particular circuit, perform a complete visual inspection in that area. See Figure 4-1 for the location of circuits. Frequently, visual inspection reveals the effect (such as burned resistors) rather than the cause of the trouble. However, these effects may give clues as to the actual cause. Care should be taken to find the real cause.

Most instrument failures will be due to tube failure. If visual inspection fails to reveal the causes of trouble, replace pertinent tube or tubes by substitution. Do not rely on tube testers to indicate whether a tube is "good" or "bad". If a tube works in a circuit it is good. Be sure to return good tubes to their original sockets.

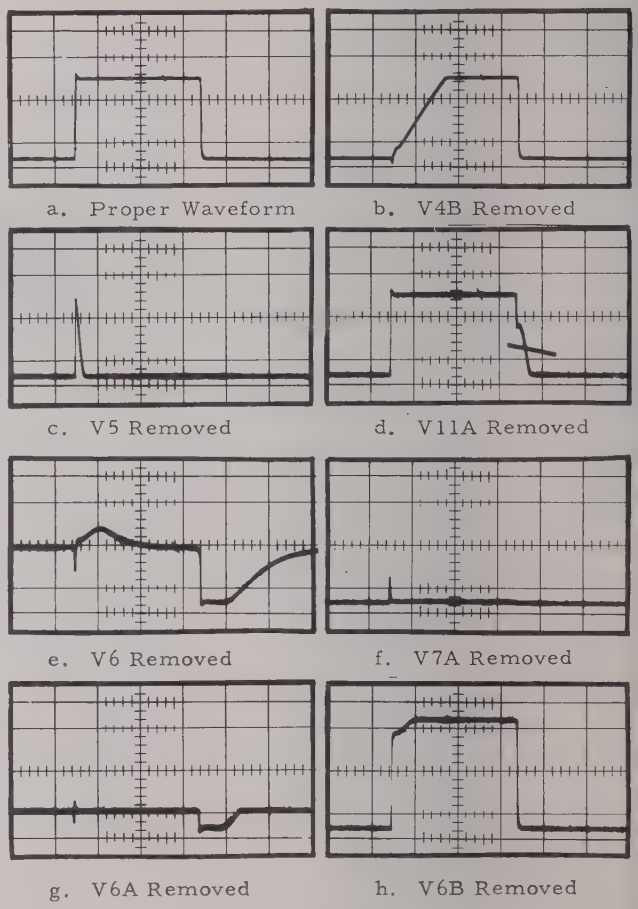


Figure 4-4. Waveform Analysis in Troubleshooting.

Photographs taken from a Tektronix 543, viewing the positive pulse output open circuit with the negative jack unterminated. Sweep speed = 2μs/cm; Vertical deflection = 20v/cm.

4.4 CALIBRATION PROCEDURE

4.4.1 General

Remove chassis from cabinet. Connect the instrument and ac voltmeter to the autotransformer output. Set at 115v ac. Allow 30 minutes warm-up before calibrating. Make sure the instrument is working properly before commencing. If any portion of the instrument fails to calibrate, repair should be effected before attempting to complete calibration.

4.4.2 Calibration Equipment Required

1. RMS reading ac voltmeter with a range of 0-150 volts (0-300 for 230 volt operation).
2. Variable line transformer with a rating of at least 3.0 amperes such as the Powerstat series 20.
3. Multimeter with a dc accuracy of 1-1/2% and sensitivity of 20,000 ohms per volt.
4. General purpose 0-30 mc bandpass scope with either delayed sweep or high sweep magnification. The Tektronix Type 543 is adequate. A dual trace plug-in is convenient but not essential.
5. Two 50-ohm one-watt terminations. Tektronix #B52-R is adequate.
6. An insulated low capacity screwdriver.

4.4.3 Power Supply Check

Since the timing circuits are dependent upon the regulated power supplies for reference any calibration should be prefaced by a thorough power supply check.

Place REPETITION RATE control on EXT. Remove any external loads from POS. or NEG. PULSE OUTPUT. Measure the output voltages (listed in column 1 of Table III) with respect to ground at those test points (see Figure 4-5) indicated in the second column. Proceed in the indicated sequence. To check the supplies for proper regulation, vary the line voltage from 105 to 125 vac. The two regulated supplies should remain essentially constant.

If a voltage (1) does not meet tolerance, (2) exceeds tabulated ripple, or (3) varies excessively with line voltage; correct the trouble before proceeding.

TABLE III

VOLTAGE CHECKS

Voltage	Test Point	Voltage Tolerance	Maximum Ripple
* +205v unreg.	TP7	±5%	4v
-108v	TP9	±5%	100mv
+105v	TP8	±5%	100mv

* It is not necessary to perform the regulation check on this voltage.

4.4.4 Repetition Rate Calibration

a. Preliminary Settings:
   1. FREQUENCY Multiplier to $X10^2$
   2. FREQUENCY Vernier to 5
   3. Pulse Delay Vernier to 0.1μs
   4. Pulse Delay Multiplier to X0.1
   5. Pulse Width Vernier fully counter-clockwise (ccw)
   6. Pulse Width Multiplier to X10

b. View on calibrated sweep oscilloscope. Adjust R8 (See Figure 4-6) for 500 cps.

c. Set FREQUENCY VERNIER to 50. Adjust R2 for 5kc.

d. Repeat step (b).

e. Set PULSE WIDTH to minimum; set FREQUENCY multiplier to $X10^4$ VERNIER to 5. Adjust C1 for 50kc

4.4.5 Pulse Delay Calibration (see Figure 4-6)

a. Preliminary Settings:
   1. Set FREQUENCY multiplier to $X10^2$; VERNIER ccw
   2. PULSE DELAY multiplier to X10; VERNIER to 10
   3. PULSE WIDTH multiplier to X0.1; VERNIER to 1

b. View POS. PULSE on a scope with a well calibrated sweep. A dual trace is convenient. Adjust R17 for 100μs delay between POSITIVE SYNC OUTPUT and POS. PULSE OUTPUT measured at 50% amplitude points.

c. Set PULSE DELAY VERNIER to 1; adjust R24 for 10μs delay.

d. Set PULSE DELAY VERNIER to 10 and repeat step b).

e. Set PULSE DELAY MULTIPLIER to X0.1; FREQUENCY MULTIPLIER to $X10^3$ and adjust C14 for 1.0μs delay.

4.4.6 Pulse Width Calibration

a. Preliminary Settings:
   1. FREQUENCY multiplier to $X10^2$; VERNIER ccw
   2. PULSE DELAY multiplier to X0.1; VERNIER cw
   3. PULSE WIDTH multiplier to X10; VERNIER on 10
   4. Terminate POS. OUTPUT in 50 ohms.

b. View POS. PULSE with oscilloscope. Adjust R30 for 100μs width of the POS. PULSE measured at the 50% amplitude points.

c. Set PULSE WIDTH VERNIER to 1; adjust R43 for 10μs wide output pulse.

d. Set PULSE WIDTH VERNIER to 10 and repeat step b.

e. Set PULSE WIDTH multiplier to X0.1; FREQUENCY multiplier to $X10^4$ and adjust C25 for 1.0μs wide output pulse.

4.5 SPECIFICATIONS VERIFICATION

The following detailed test was performed on this instrument just prior to shipment to confirm published specifications. Before the test was conducted this instrument had been thoroughly aged and had undergone rigid examination for workmanship and appearance. This procedure is provided to assist you in performing tests of this type.

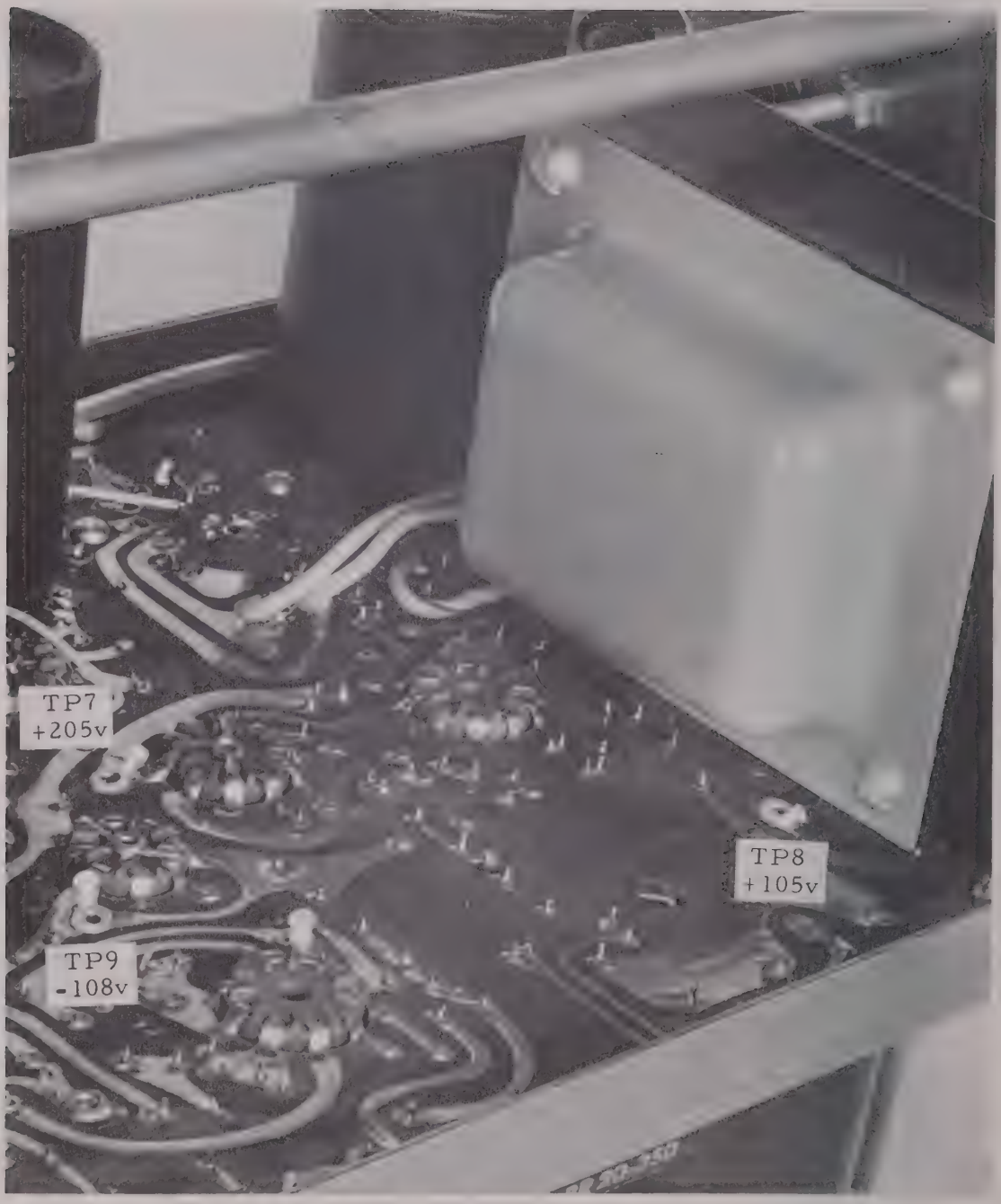


Figure 4-5. Power Supply Test Points.

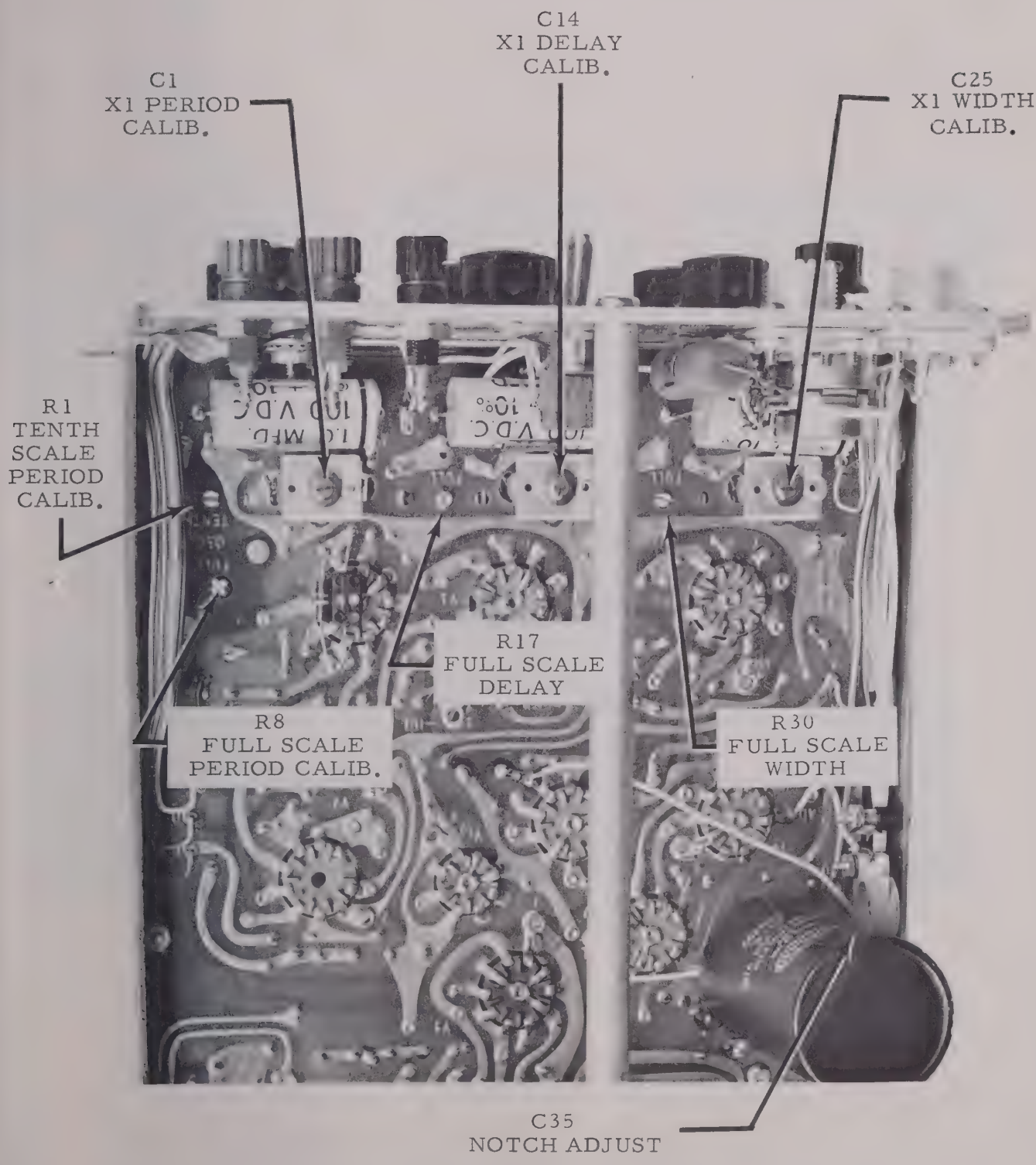


Figure 4-6a. Calibration Adjustments

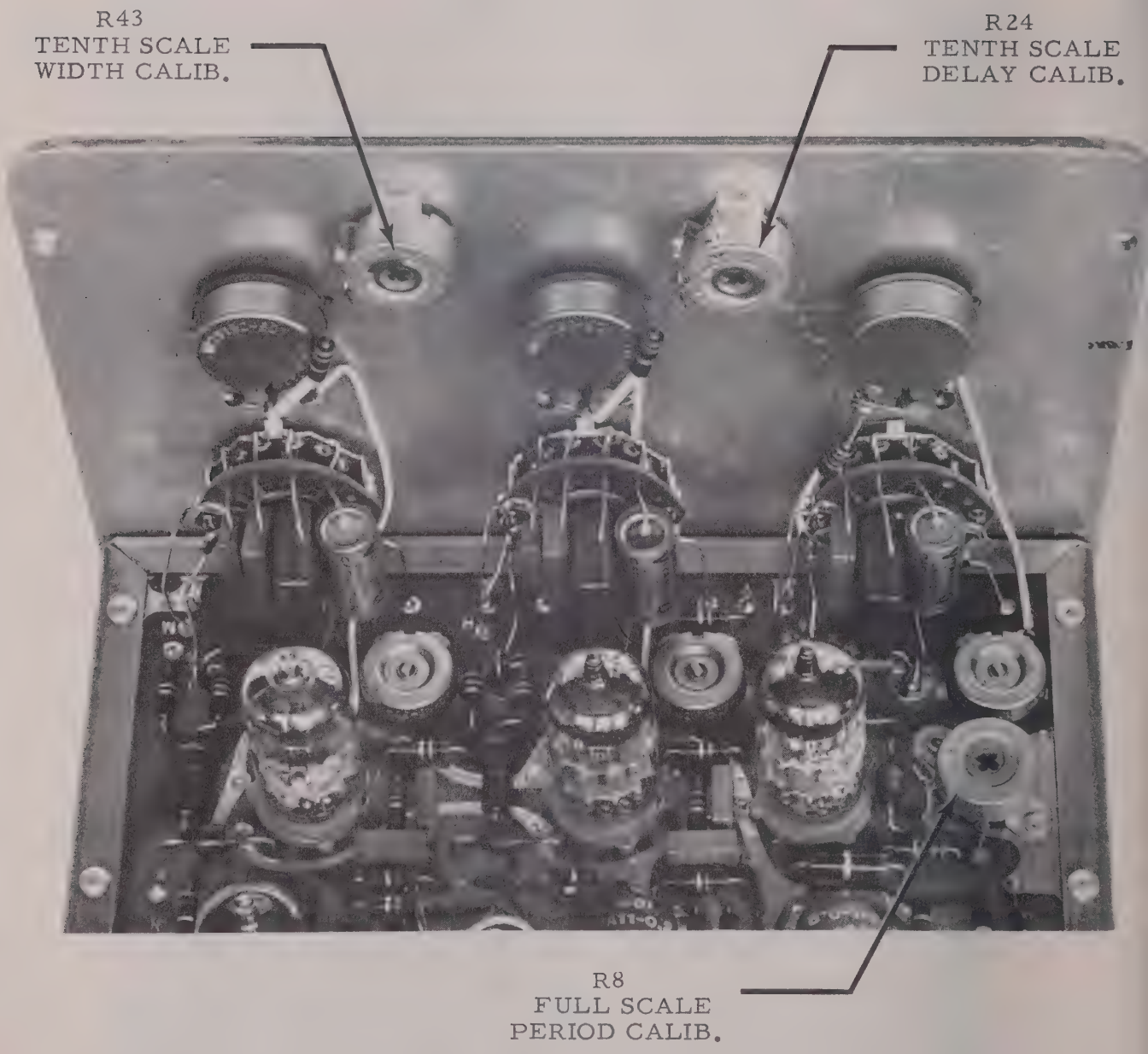


Figure 4-6b. Calibration Adjustments

Recalibrate and/or troubleshoot the instrument if specifications are not verifiable.

4.5.1 Equipment Required

Oscilloscope, 30 mc

Two each 50-ohm terminations

Trigger generator

UHF shorting cap

4.5.2 Repetition Rate

a. Oscillator Timing:

Set PULSE DELAY multiplier to X0.1, VERNIER ccw. Follow the panel control setting sequence shown in Table IV. The spacing between pulses should be 4 centimeters (±0.2 centimeters when the FREQUENCY VERNIER is on 5. When the VERNIER is fully cw there should be 4 cm or less between pulses.

TABLE IV

REPETITION RATE CALIBRATION CHECK

Frequency Range	Scope Sweep Speed		Pulse Width
	Frequency Vernier on 5	Frequency Vernier Fully ccw	
X1	50 ms/cm	5 ms/cm	1 ms
X10	5 ms/cm	.5 ms/cm	100 μs
$X10^2$	.5 ms/cm	50 μs/cm	10 μs
$X10^3$	50 μs/cm	5 μs/cm	1 μs
$X10^4$	5 μs/cm	.5 μs/cm	.1 μs

b. Jitter:

Set PULSE DELAY to minimum, PULSE WIDTH to 10μs. Set FREQUENCY multiplier to $X10^3$; VERNIER to 5. Set scope sweep speed to 20 μs/cm. Expand sweep to X20. View second pulse. Jitter should not exceed 1 cm (0.5%).

c. Stability:

Set generator controls as in b. Set scope sweep speed to 20μs/cm. Expand sweep to X5. The shift of the second pulse with respect to the first, as the line voltage is varied from 105-125, should not exceed 2 cm (2%).

d. External Triggering:

Apply a 0.1μs rise time positive trigger to the POSITIVE EXTERNAL TRIGGER INPUT jack. Verify that the Model 100 will be slaved to repetition rates up to 500 kc with 15v and to 1 mc with 25v.

e. Sync Pulse:

Set DELAY and WIDTH controls at minimum. Set FREQUENCY controls at minimum (500 kc). Measure the amplitude of each sync output. Verify that the POS. SYNC OUTPUT is greater than 20v and that the NEG. SYNC OUTPUT is greater than 5v.

4.5.3 Pulse Delay

a. Delay Timing:

Sync scope from POSITIVE SYNC OUTPUT. View sync pulse and POSITIVE OUTPUT PULSE simultaneously (dual trace). Note that delay is measured from the 50% point on the leading edge of the sync pulse to the 50% point on the leading edge of the output pulse. To check pulse delay timing, refer to the panel control sequence shown in Table V.

TABLE V

PULSE DELAY CALIBRATION CHECK

Frequency	Pulse Width	Delay Multiplier	Delay Vernier	Scope Sweep Speed
50 cps	100 μs	$X10^4$	10	20 ms/cm
5 cps	100 μs	$X10^3$	10	2 ms/cm
50 cps	100 μs	$X10^2$	10	.2 ms/cm
500 cps	1 μs	X10	10	20 μs/cm
5 kc	1 μs	X1	10	2 μs/cm
50 kc	1 μs	X0.1	10	.2 μs/cm
50 kc	1 μs	X0.1	CCW	.2 μs/cm
50 kc	1 μs	X1	CCW	.2 μs/cm
5 kc	1 μs	X10	CCW	2 μs/cm
500 cps	1 μs	$X10^2$	CCW	20 μs/cm
50 cps	100 μs	$X10^3$	CCW	.2 ms/cm
5 cps	100 μs	$X10^4$	CCW	2 ms/cm

For the DELAY VERNIER set at 10, the spacing on the scope face should be 5 cm ±.25 cm. For the DELAY VERNIER set fully ccw, the scope reading should be 1 cm on the X0.1 range and 5 cm or less on all other ranges.

b. Delay Duty Cycle:

Set FREQUENCY to 5kc, PULSE WIDTH to 10 μs, scope sweep speed to 0.2 ms/cm. With the PULSE DELAY multiplier on on $X10^2$, slowly turn the PULSE DELAY VERNIER cw and verify that 80% (8 cm) duty cycle can be obtained without circuit failure.

c. Delay Jitter:

With PULSE DELAY multiplier on $X10^2$, set PULSE DELAY VERNIER to 10, PULSE WIDTH to 10 μs, FREQUENCY at 500 cps, scope sweep speed at 0.1 ms/cm. Expand the sweep to X100. View the leading edge of the pulse. Jitter should be less than 1/2 cm (0.1%).

d. Delay Stability:

Set your Model 100 controls as in c. above. Set the scope sweep speed at 0.1 ms/cm. Expand sweep to X5. The shift of the POS. OUTPUT with respect to sync, as the line voltage is varied from 105 to 125, should not exceed 2 cm (2%).

4.5.4 Pulse Width

a. Width Timing:

Sync scope from leading edge of POS. PULSE OUTPUT and view the POS. PULSE OUTPUT. Set PULSE DELAY at minimum. Note that width is measured from the 50% amplitude point on the leading edge to the half amplitude point on the trailing edge of the output pulse. To check pulse width timing, refer to the panel control sequence shown in Table VI. For PULSE WIDTH VERNIER set at 10, the spacing on the scope face should be 5 cm ±.25 cm. For the PULSE WIDTH VERNIER set fully ccw the scope reading should be 1 cm on the X0.1 cm range and 5 cm or less on all other ranges.

TABLE VI

PULSE WIDTH CALIBRATION CHECK

Frequency	Pulse Width Multiplier	Width Vernier	Scope Sweep Speed
5 cps	$X10^4$	10	20 ms/cm
5 cps	$X10^3$	10	2 ms/cm
50 cps	$X10^2$	10	.2 ms/cm
500 cps	X10	10	20 μs/cm
5 kc	X1	10	2 μs/cm
50 kc	X0.1	10	.2 μs/cm
50 kc	X0.1	CCW	.2 μs/cm
50 kc	X1	CCW	.2 μs/cm
5 kc	X10	CCW	2 μs/cm
500 c/s	$X10^2$	CCW	20 μs/cm
50 c/s	$X10^3$	CCW	.2 ms/cm
5 c/s	$X10^4$	CCW	2 ms/cm

b. Width Duty Cycle:

Set FREQUENCY to 5kc, PULSE DELAY to minimum. Scope Sweep Speed to 0.2 ms/cm. With the PULSE WIDTH multiplier on $X10^2$, slowly turn the PULSE WIDTH VERNIER cw and verify that 80% (8 cm) duty cycle can be obtained without circuit failure.

c. Width Jitter:

With PULSE WIDTH multiplier on $X10^2$, set PULSE WIDTH VERNIER to 10, PULSE DELAY to minimum, FREQUENCY at 500 cps, scope sweep speed at 0.1 ms/cm. The scope sweep must be triggered from the leading edge of the POS. PULSE OUTPUT. Expand the sweep X100. View the trailing edge of the pulse. Jitter of the trailing edge with respect to the leading edge should be less than 1/2 cm (0.1%).

4.5.5 Output Pulse Waveform

a. Amplitude:

Set FREQUENCY multiplier at $X10^4$, vernier at 50; pulse delay multiplier at X0.1, vernier ccw; pulse width multiplier at X0.1, vernier ccw; amplitude control fully clockwise, sync scope from POS. SYNC OUTPUT. View negative output pulse, unterminated. Output should be at least 35v. View negative output pulse, unterminated. Output should be at least 80v. Terminate each output in 50 ohms. Readjust amplitude control for optimum waveform. View positive output pulse. Output should be at least 10v. View negative output pulse. Output should be at least 10v.

b. Overshoot:

Set FREQUENCY to 10kc, width to 1μs. Overshoot should be less than 5% (it may be necessary to readjust overshoot control somewhat).

c. Rise Time:

Set FREQUENCY to 10kc, width to 1μs. Refer to paragraph 1.6.2 for maximum transition times.

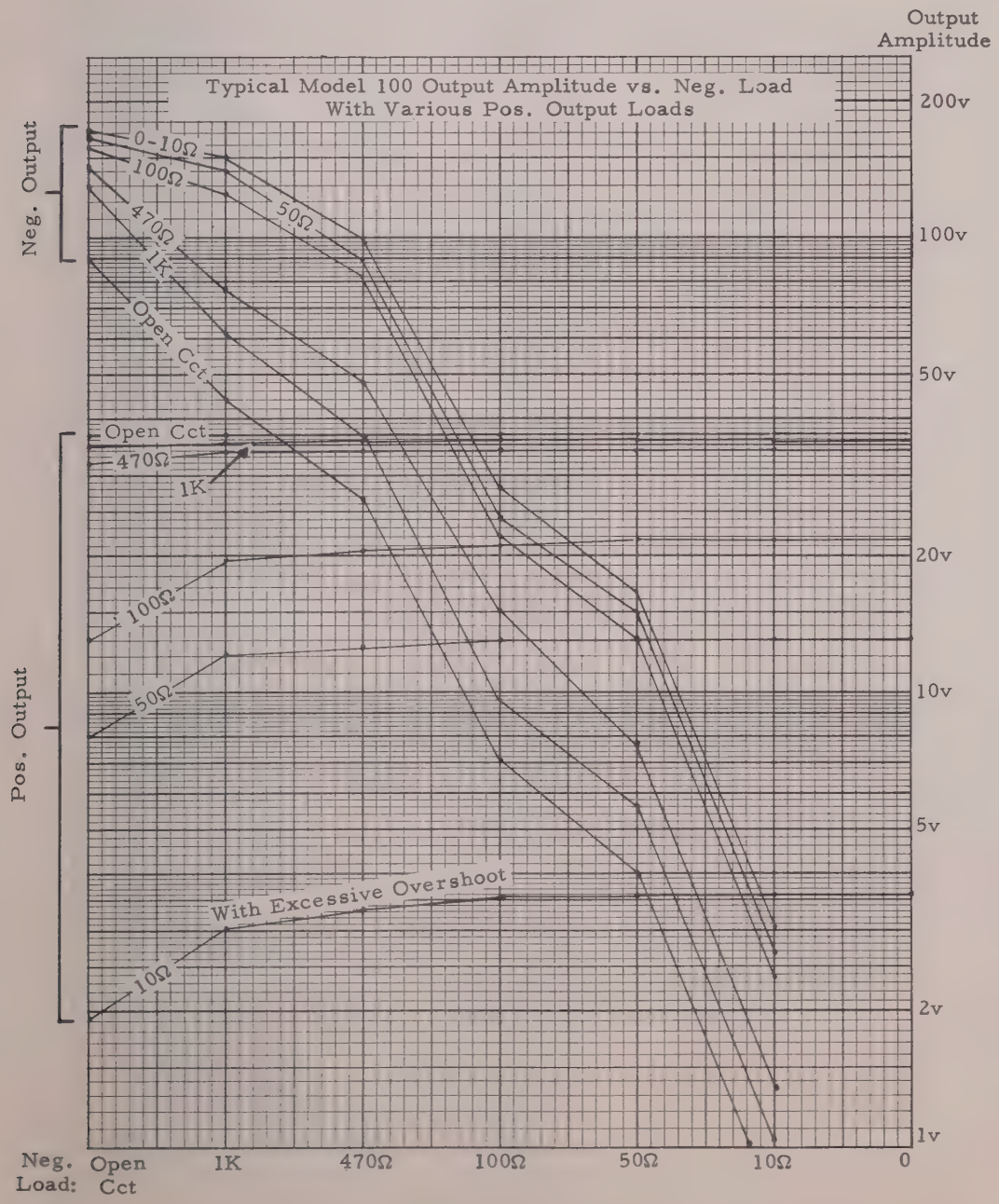
d. Top Slope:

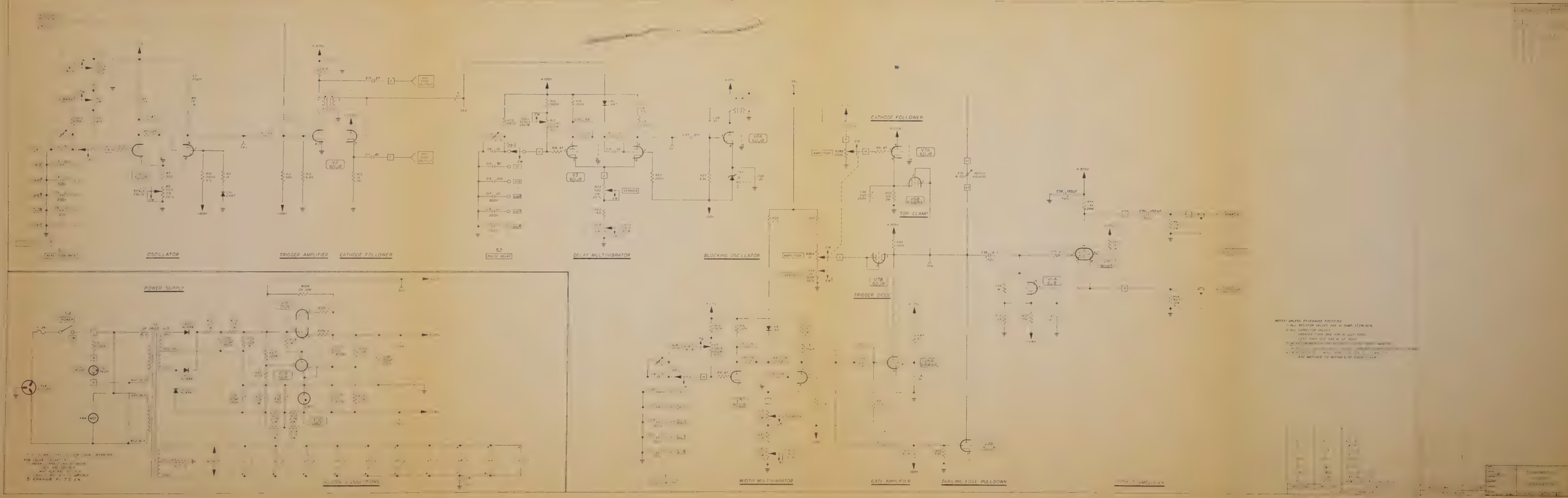
Set FREQUENCY to 5 cps, pulse width to 100 ms. Terminate both outputs in 50 ohms. Positive pulse top slope should be 6% or less; negative pulse top slope should be no greater than 20%.

REMARKS TSR-R.U-64

MODEL 100 PULSE GENERATOR
SIMULTANEOUS OUTPUT CAPABILITIES

The Model 100 Pulse Generator provides simultaneous positive and negative outputs, from the cathode and plate respectively of a single output tube. The data plotted below is indicative of the output amplitude which may be expected as a function of load impedance, with various loads on the opposite polarity output jack. To facilitate realization of these characteristics, DATAPULSE has recently made available the Type 2003 50 ohm dummy load (UHF male connector), for loading of the unused output when near-maximum amplitude output is required.




OSCILLATOR
TRIGGER AMPLIFIER
CATHODE FOLLOWER
52
PULSE DELAY
DELAY MULTIVIBRATOR
BLOCKING OSCILLATOR
CATHODE FOLLOWER
TOP CLAMP
TRIGGER DIODE
POWER SUPPLY
WIDTH MULTIVIBRATOR
GATE AMPLIFIER
TRAILING EDGE PULLDOWN

INSTRUMENT CERTIFICATION

Model 100 SN# 103

Instrument has been aged for 24 hours and fully calibrated prior to this test ✓

REPETITION RATE

Oscillator Covers 5 CPS to 500 KC ✓
Accuracy ± 5% ✓
Jitter ≤ 0.5% ✓

EXTERNAL TRIGGER

+15v Pulse Drive Required
from 0 CPS to 500 KC ✓
+25v to 1 mc ✓

SYNC PULSE

Amplitude > Pos. 20v at 500 KC and Negative 5v ✓

MAIN PULSE DELAY

Delay covers 0.2 μsec to 100 ms ✓
Accuracy ± 5% ✓
Maximum duty cycle ≥ 80% ✓
Jitter ≤ 0.1% ✓

MAIN PULSE DURATION

Duration covers 0.1 μsec. to 100 ms ✓
Accuracy ± 5% ✓
Jitter ≤ 0.1% ✓

MAIN PULSE OUTPUT

Positive pulse open circuit amplitude, negative jack open circuited, at least 35v ✓
Positive pulse amplitude into 50Ω, negative jack terminated in 50Ω, at least 10v ✓
Negative pulse open circuit amplitude, positive jack open circuited, at least 80v ✓
Negative pulse open circuit amplitude, positive jack shorted, at least 150v ✓
Negative pulse amplitude into 50Ω, positive jack terminated in 50Ω, at least 10v ✓

WAVEFORM

Overshoot variable to 5% ✓
Positive pulse top slope less than 3% for durations less than 10 ms ✓
Positive pulse top slope less than 6% for pulse durations of 100 ms ✓
Negative pulse top slope less than 3% for duration less than 2 ms ✓
Negative pulse top slope less than 20% for duration of 100 ms with 50Ω ✓
Positive pulse rise time less than 30 ns ✓
Negative pulse open circuit rise time (positive jack open circuit) less than 120 ns ✓
Negative pulse open circuit rise time (positive jack shorted) less than 50 ns ✓
Negative pulse rise time intp 50Ω (positive jack terminated in 50Ω) less than 30 ns ✓
Positive pulse open circuit fall time (negative jack open circuit) less than 80 ns ✓
Positive pulse fall time into 50Ω load (negative jack terminated into 50Ω) less than 40 ns ✓
Negative pulse open circuit fall time less than 200 ns ✓
Negative pulse fall time into 50Ω (positive pulse terminated in 50Ω) less than 40 ns ✓

I certify that this instrument meets all of the above specifications and conforms to DATAPULSE Standard 91200-000 16 workmanship and appearance.

Q. C. ACCEPTANCE
DATE 23 JUN 1964
INSPECTOR (S)

SIGNED Sam Abeloha
Final Test Inspector

DATE 6/22/64

WARRANTY

Datapulse Incorporated warrants each instrument of its manufacture to be free from defects in material and workmanship. Our obligation under this Warranty is limited to servicing or adjusting any instrument returned to our factory for that purpose, and to making good at our factory any part or parts thereof except tubes, transistors, fuses or batteries which shall, within one year after making delivery to the original purchaser, be returned to us with transportation charges prepaid, and which our examination shall disclose to our satisfaction to have been thus defective.

Instruments returned under this Warranty will not be accepted at the Datapulse plant without prior authorization by a Datapulse representative or by the service manager of Datapulse Incorporated.

Datapulse Incorporated reserves the right to make changes in design at any time without incurring any obligation to install same on units previously purchased.

This Warranty is expressly in lieu of all other obligations or liabilities on the part of Datapulse Incorporated and Datapulse Incorporated neither assumes nor authorizes any other person to assume for them any other liability in connection with the sales of Datapulse Incorporated instruments.

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